NYC Environmental Protection

CSO-LTCP-02

CSO Long Term Control Planning II

Newtown Creek

Meeting With EPA/DEC

February 16, 2017

Agenda

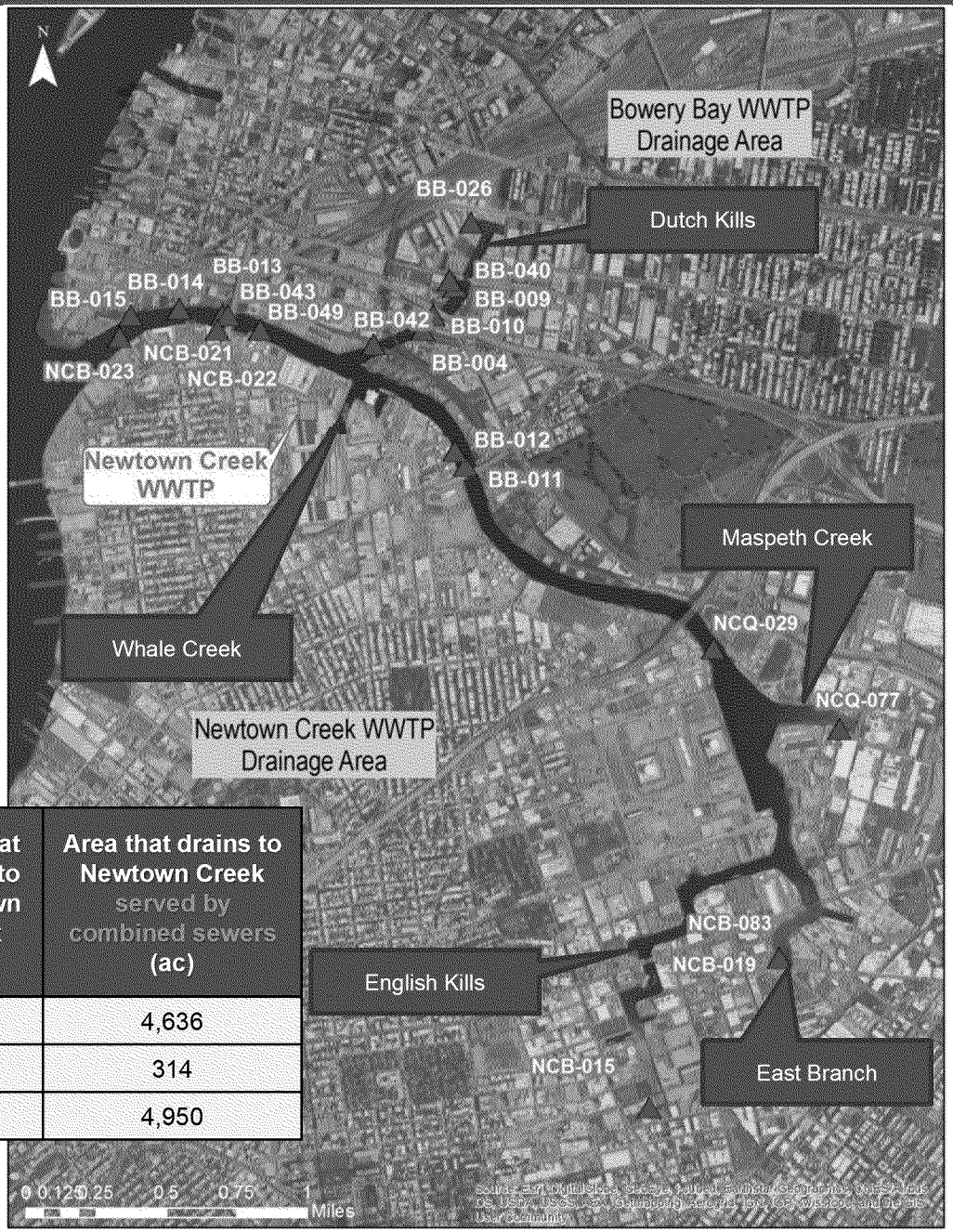
	Topic
1	Background/Waterbody & Watershed Characteristics
2	WQ Sampling Results
3	WQ Improvement Projects/Investments to Date
4	Baseline Modeling and WQS attainment
5	CSO Control Alternatives and Siting
6	LTCP Schedule
7	Next Steps

Summary/Take-Aways

- Focus of meeting is on LTCP CWA issues
- Major project likely required to achieve WQS
- Assessing a range of levels of CSO control (25, 50, 75, 100% Control)
- Siting will be a challenge for all options
- CSO volume reduction will have co-benefits of solids load reduction
- Bacteria and sediment models still being calibrated; expect to have in March

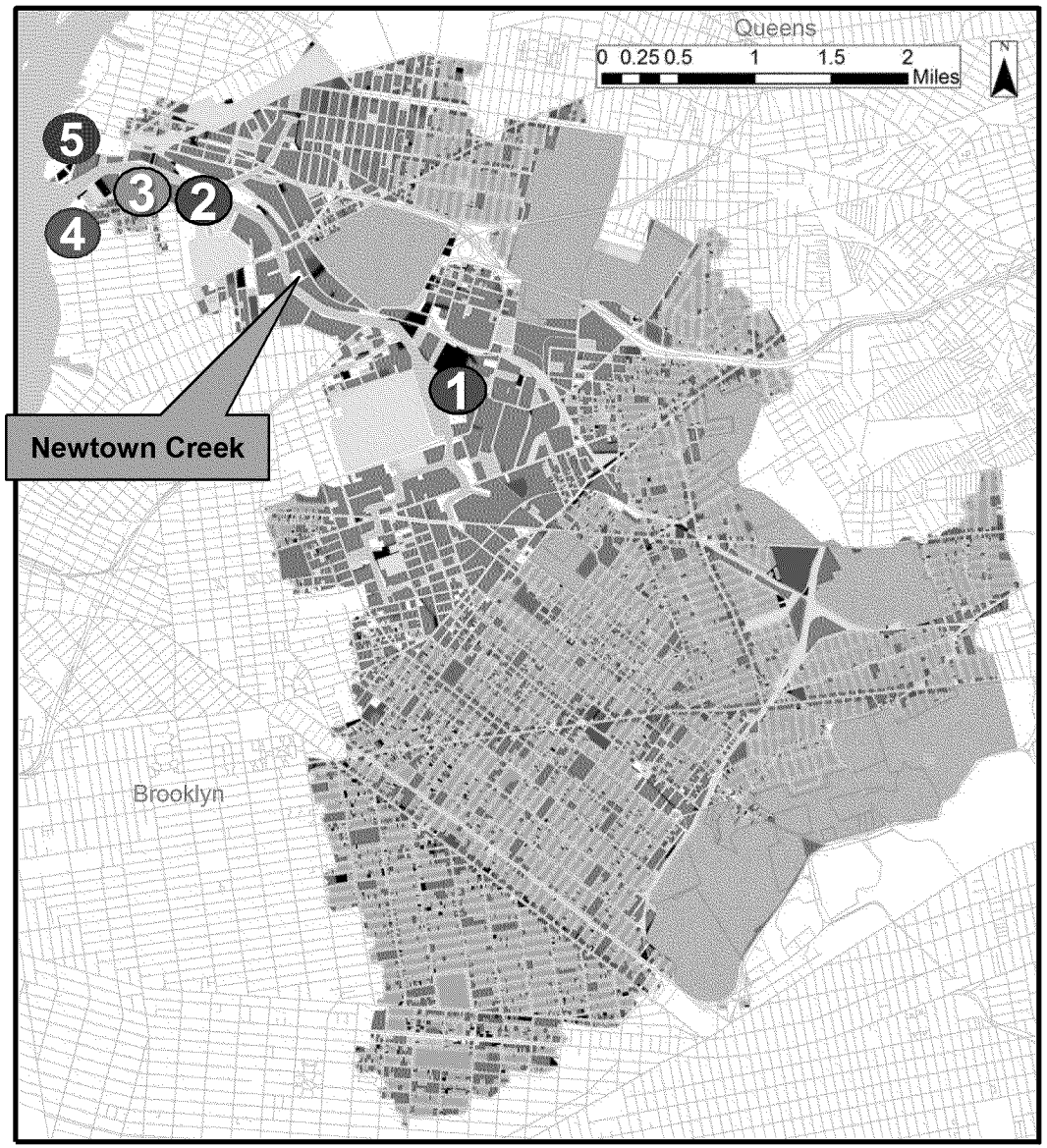
Background/Waterbody& Watershed Characteristics

Newtown Creek Waterbody



WWTP	Total Drainage Area (ac)	Area that drains to Newtown Creek (ac)	Area that drains to Newtown Creek served by combined sewers (ac)
NC	15,033	5,577	4,636
BB	14,928	1,865	314
Total		7,442	4,950

Newtown Creek Watershed



LEGEND

- Residential
- Mixed Residential and Commercial
- Commercial and Office
- Industrial and Manufacturing
- Transportation and Utility
- Park Facilities and Institutions
- Open Space and Outdoor Recreation
- Parking Facilities
- Vacant Land
- Cemetery

Land Use	NC Watershed
Residential	37%
Commercial	7%
Industrial and Transportation	24%
Public Facilities	5%
Open Space and Outdoor	22%
Other	6%

Waterfront Public Access without Boat Launch Ramp

1. Plank Road Street End (Maspeth, Queens)
2. DEP NC WWTP Nature Walk (Brooklyn)

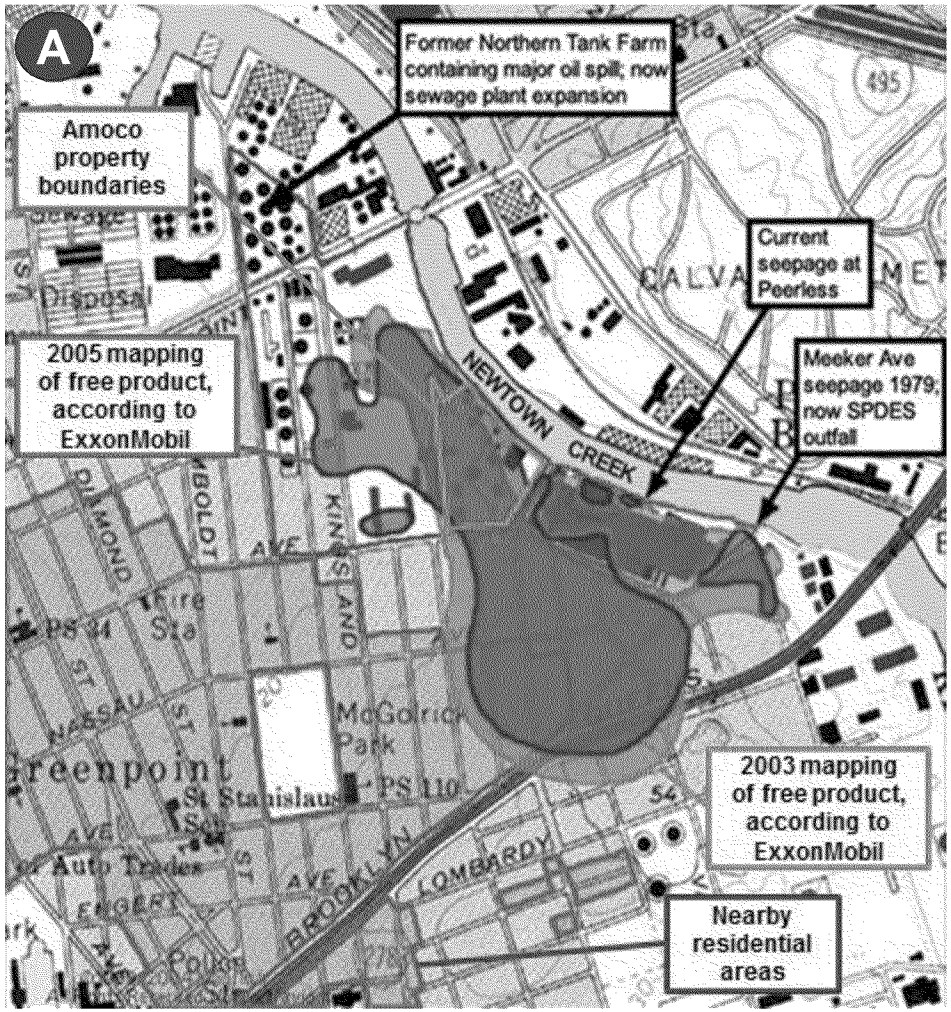
Waterfront Public Access with Boat Launch Ramp

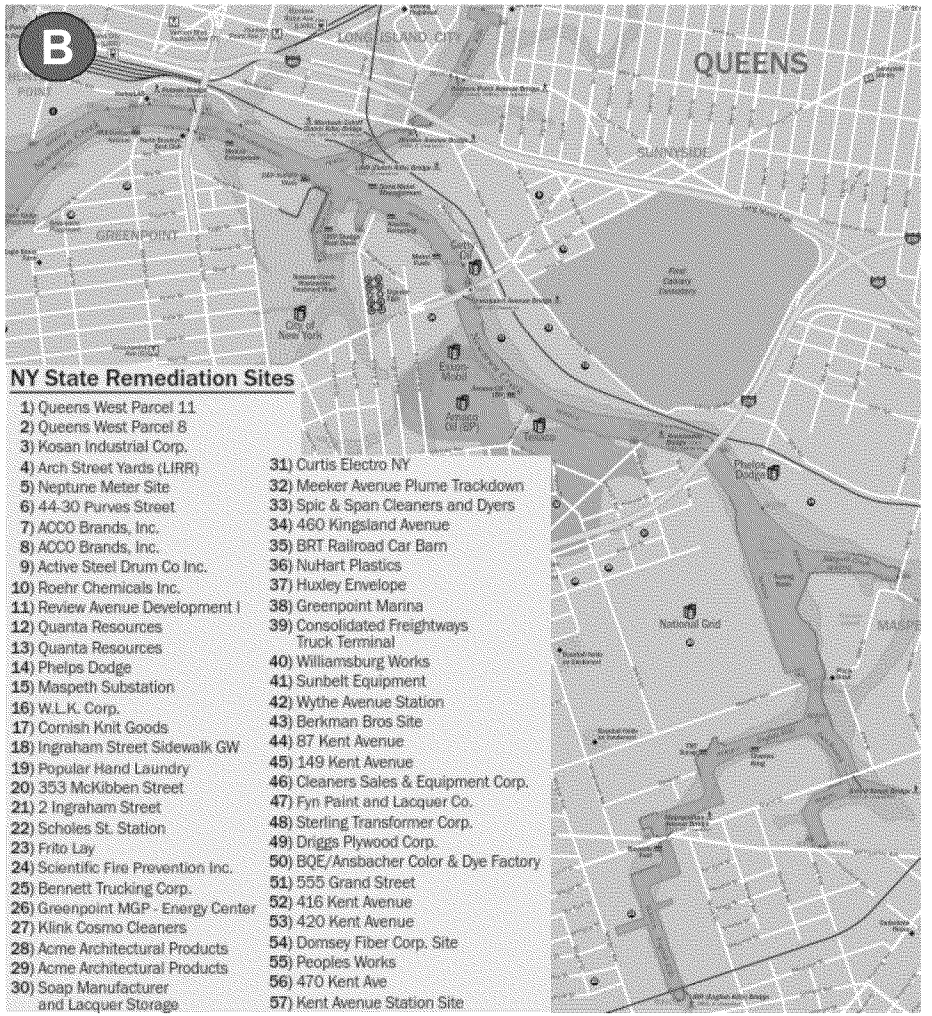
3. Manhattan Avenue Street End Park (Brooklyn)

Developments

4. **Greenpoint Landing High-Rise Residential Towers**
5. **Hunter's Point South Housing Development**

Major Newtown Creek Remedial Projects





A) Greenpoint Oil Spill Remediation

- 2nd largest oil spill in US history
- As of 2015, 12.5 MG of petroleum product have been removed
- Current remediation taking place under supervision of NYS DEC

B) Newtown Creek Remedial Sites

- Multiple contaminated sites surrounding Newtown Creek
- Often remnants of old industrial operations
- NYS DEC currently working with property owners to investigate and clean up these remedial sites

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Water Quality Sampling Results

Water Quality Standards & LTCP Goals

CLASS SD

Fish Survival

The best usage of Class SD water is fishing. These waters shall be suitable for fish, shellfish, and wildlife survival. In addition, the water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.

Parameter	Criteria*	DEC Water Quality Parameter Reference
Fecal Coliform	Monthly Geometric Mean ≤ 200 col/100 mL	• New York Codes, Rules and Regulations • (NYCRR Part 703.4)
Total Coliform	Monthly Geometric Mean ≤ 2,400 col/100 mL 80% ≤ 5,000 col/100 mL	• New York Codes, Rules and Regulations • (NYCRR Part 703.4)
Dissolved Oxygen	≥ 3.0 mg/L (acute, never less than)	• New York Codes, Rules and Regulations • (NYCRR Part 703.3)

* EPA has also proposed a potential future RWQC for enterococcus: 30-Day Rolling GM ≤ 30 col/100 mL.

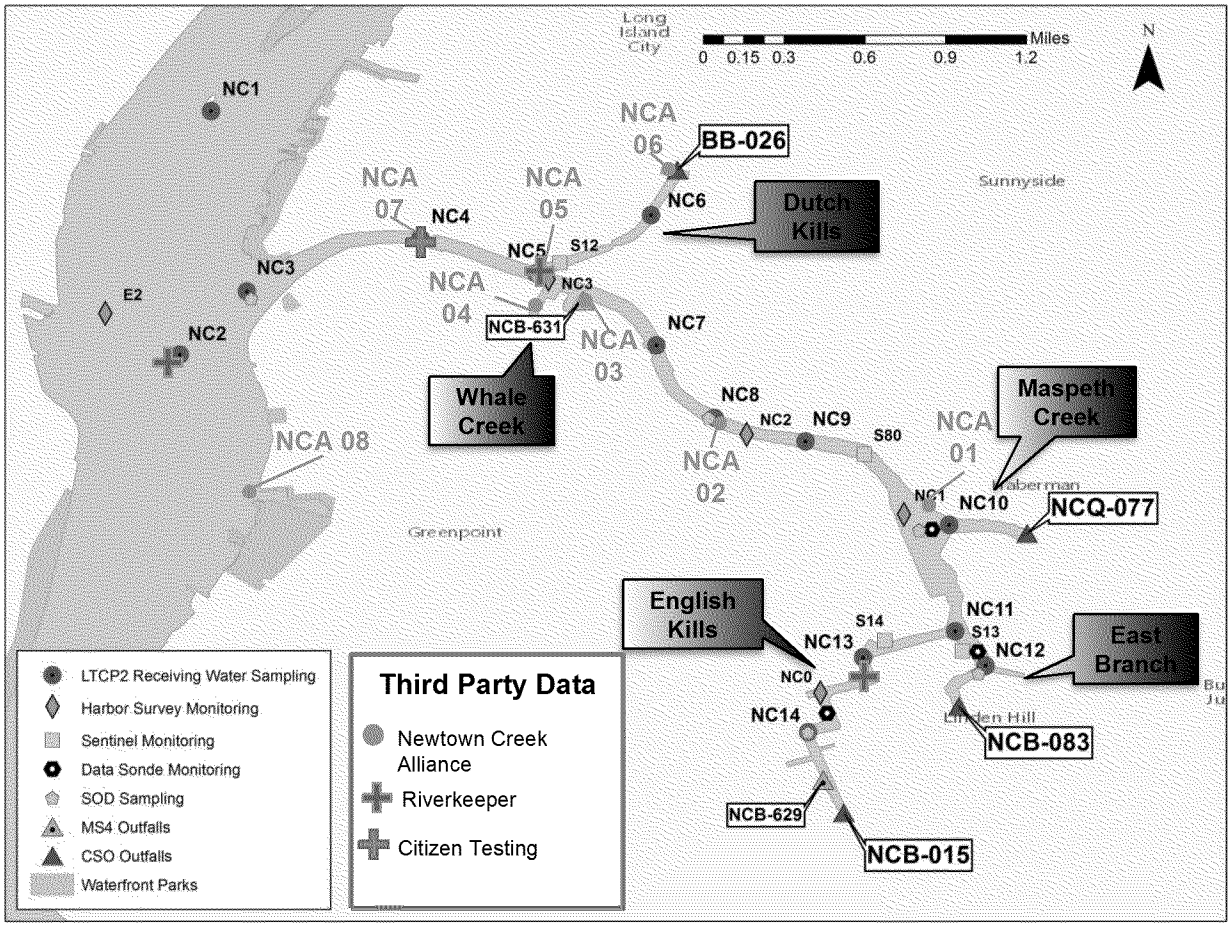
CSO LTCP Goals and Targets:

- Seasonal Bacteria Compliance
- Annual Dissolved Oxygen Compliance
- Time to Recovery for Bacteria of ≤ 24 hours
- Floatables Control

Sampling and Monitoring Programs

Sampling Period: 7/1/2016 – 10/31/2016

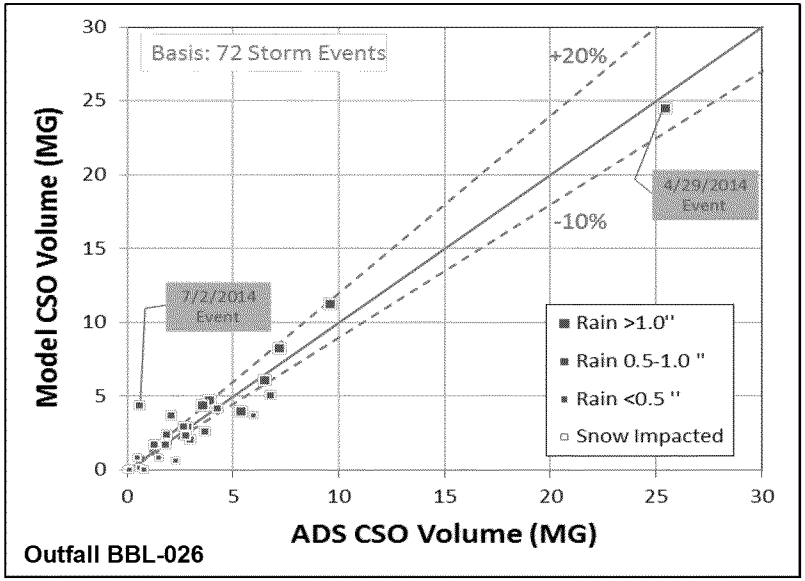
- **CSO/MS4 Sampling**
  - 4 CSO, 2 MS4 locations
  - 4 wet weather events
  - Fecal, Entero, YSI
- **Receiving Water (14)**
  - 14 locations
  - Four 4-day events
  - Fecal, Entero, YSI
- **Sediment Oxygen Demand**
  - 6 receiving water locations
  - 1 dry & 3 wet-weather events
- **Data Sondes**
  - 3 receiving water locations
  - Continuous over 60 days
  - DO
- **Flow Monitoring**
  - 3/1/2014 – 3/31/2015
  - 5 locations
  - Continuously monitored
  - Depth & Velocity measurements

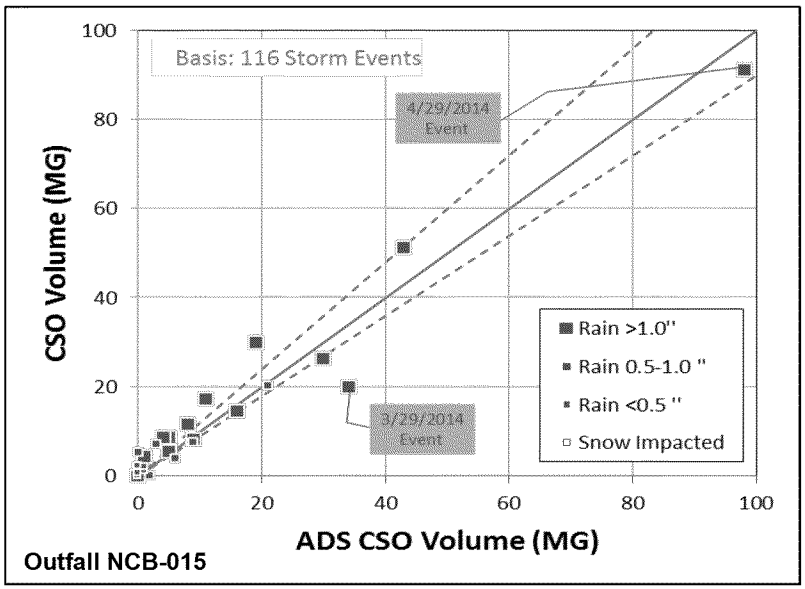


- **NC Alliance**
  - 8 receiving water locations
  - Entero, DO
- **Riverkeeper/Citizen**
  - 4 receiving water locations
  - Entero, DO

Newtown Creek Landside Model Calibration

- DEP's process for flow monitoring and modeling has been **nationally peer reviewed and published**
- DEP implemented that process to update and validate its Newtown Creek sewer system model based upon:
  - Field surveys and record drawings of physical structures.
  - A validation dataset based upon a **12-month** sewer-monitoring program and extensive data analyses.
  - Data was analyzed using WaPUG approved methodologies and showed very good correlation.
  - Model turned over to NCG

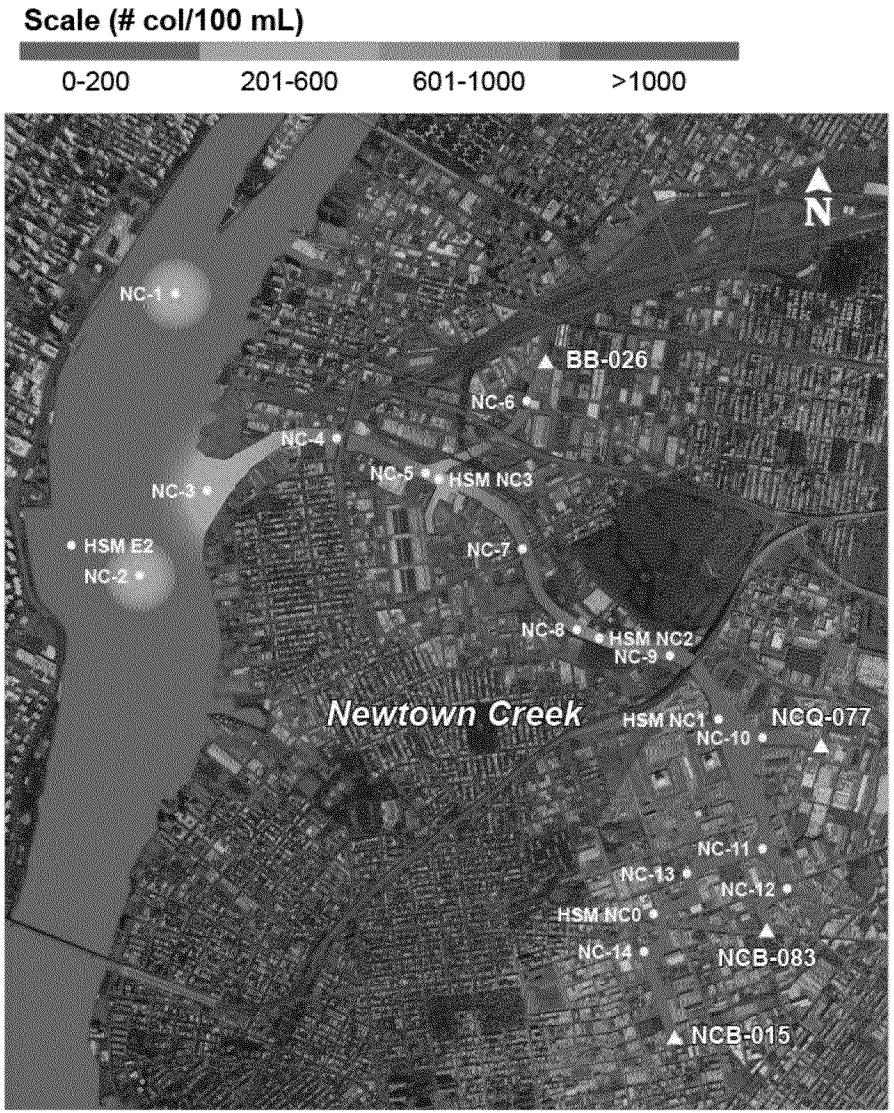




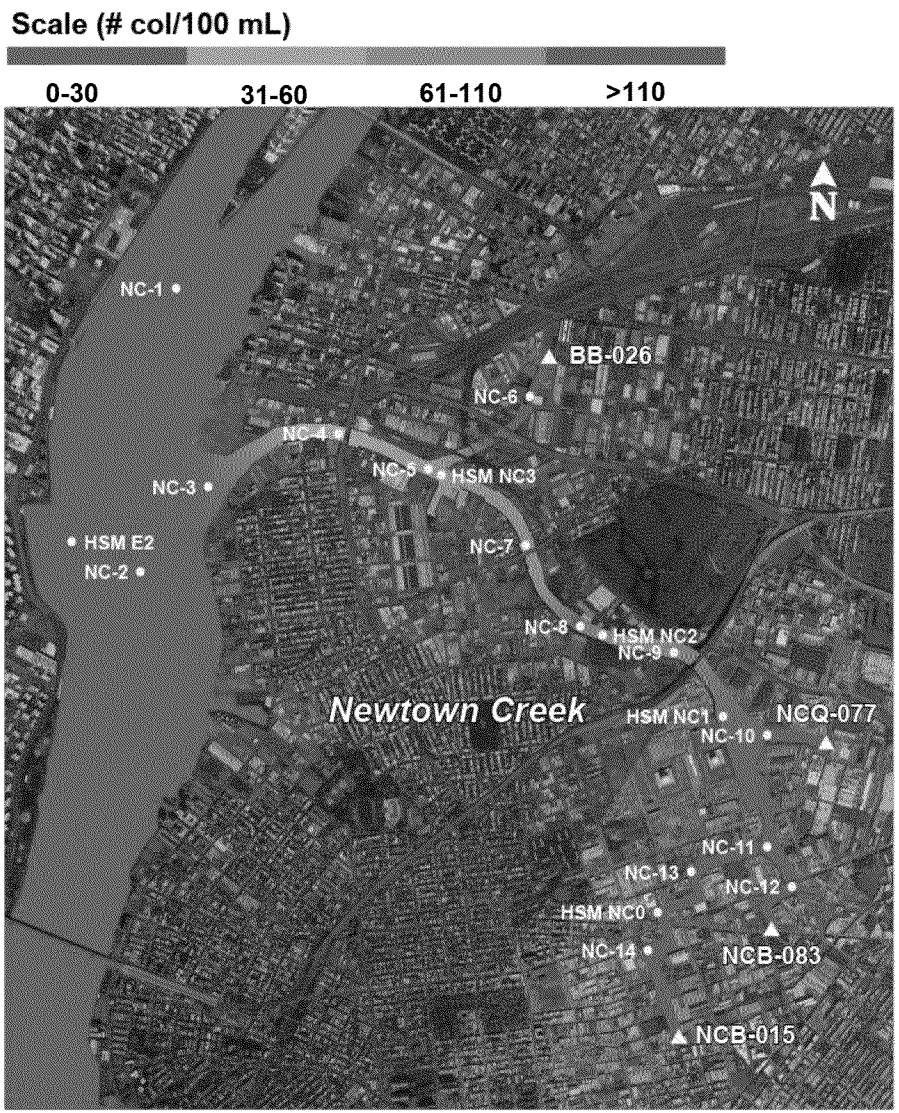
Annual Bacteria Geomeans

- LTCP: ~77 Wet samples per location; July – November 2016
- HSM: ~34 Wet samples per location; January – November 2016

Fecal – Wet Weather



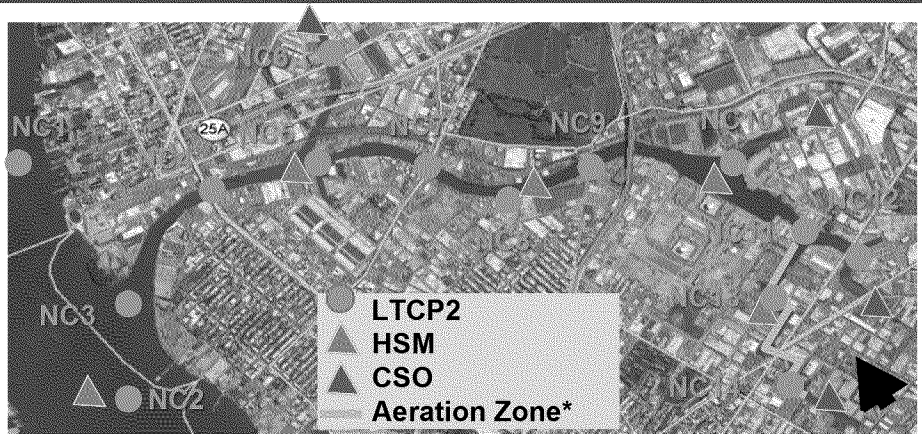
Entero – Wet Weather



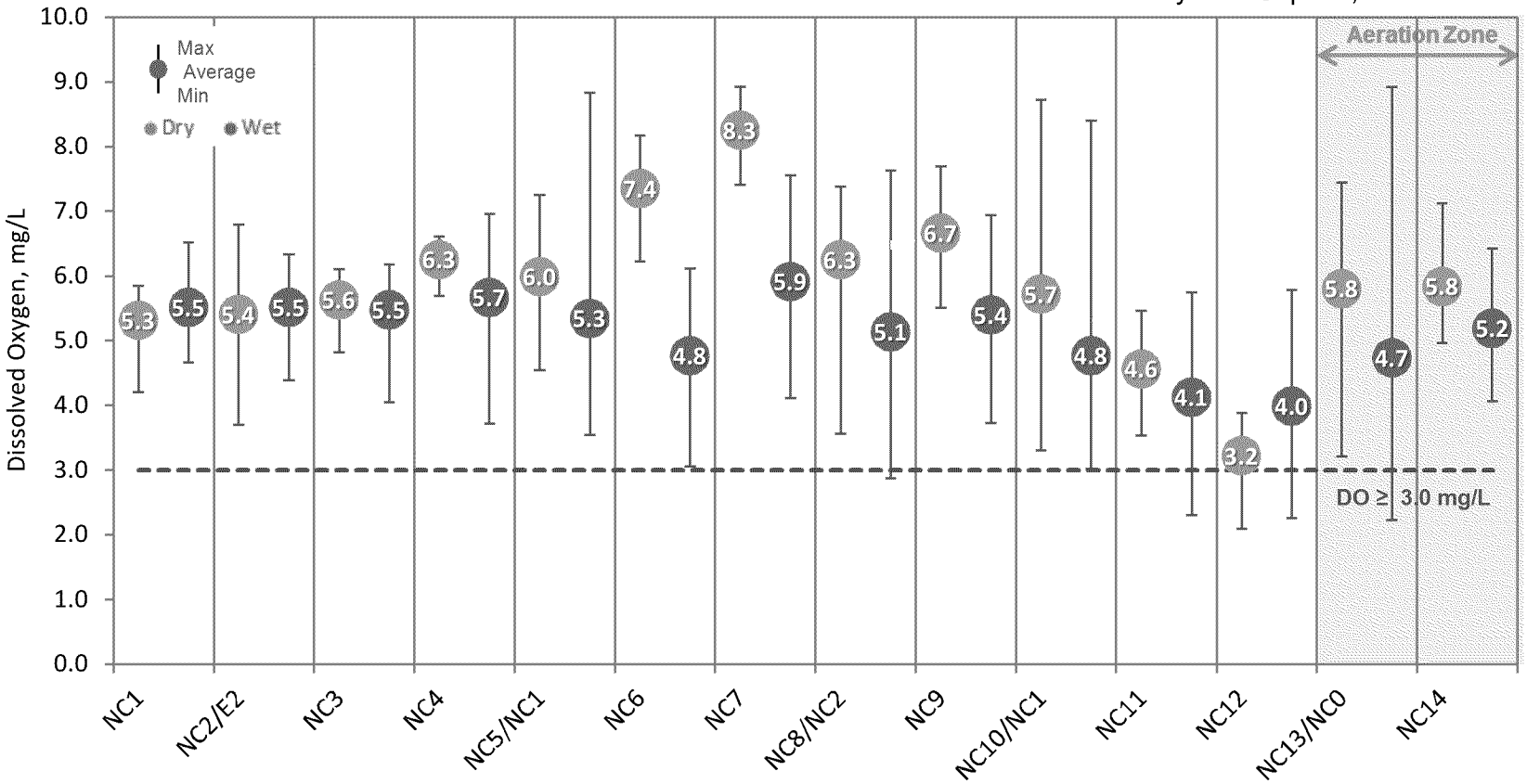
Dissolved Oxygen with Aeration Operating

Sampling During Operation of Aeration System:
May 15 – September 30, 2016

LTCP2: ~ 6 Dry and 37 Wet Weather Samples per location
HSM: ~ 10 Dry and 28 Wet Weather Samples per location



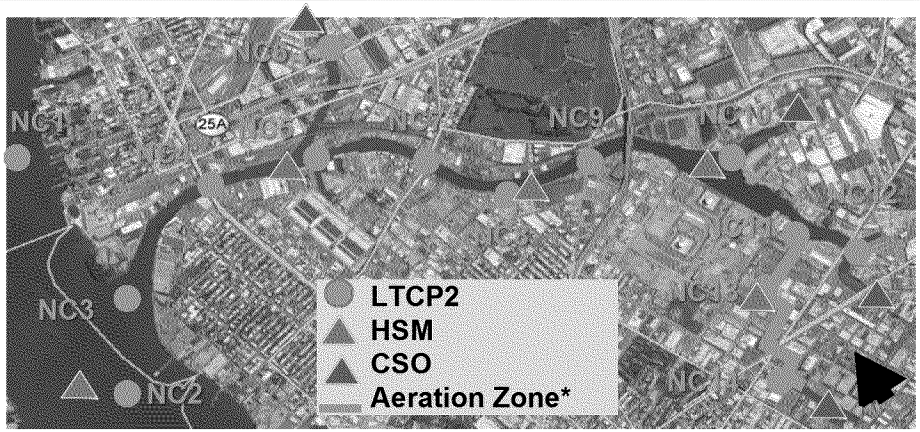
* Note: Aeration on May 15 – Sept 30, 2016



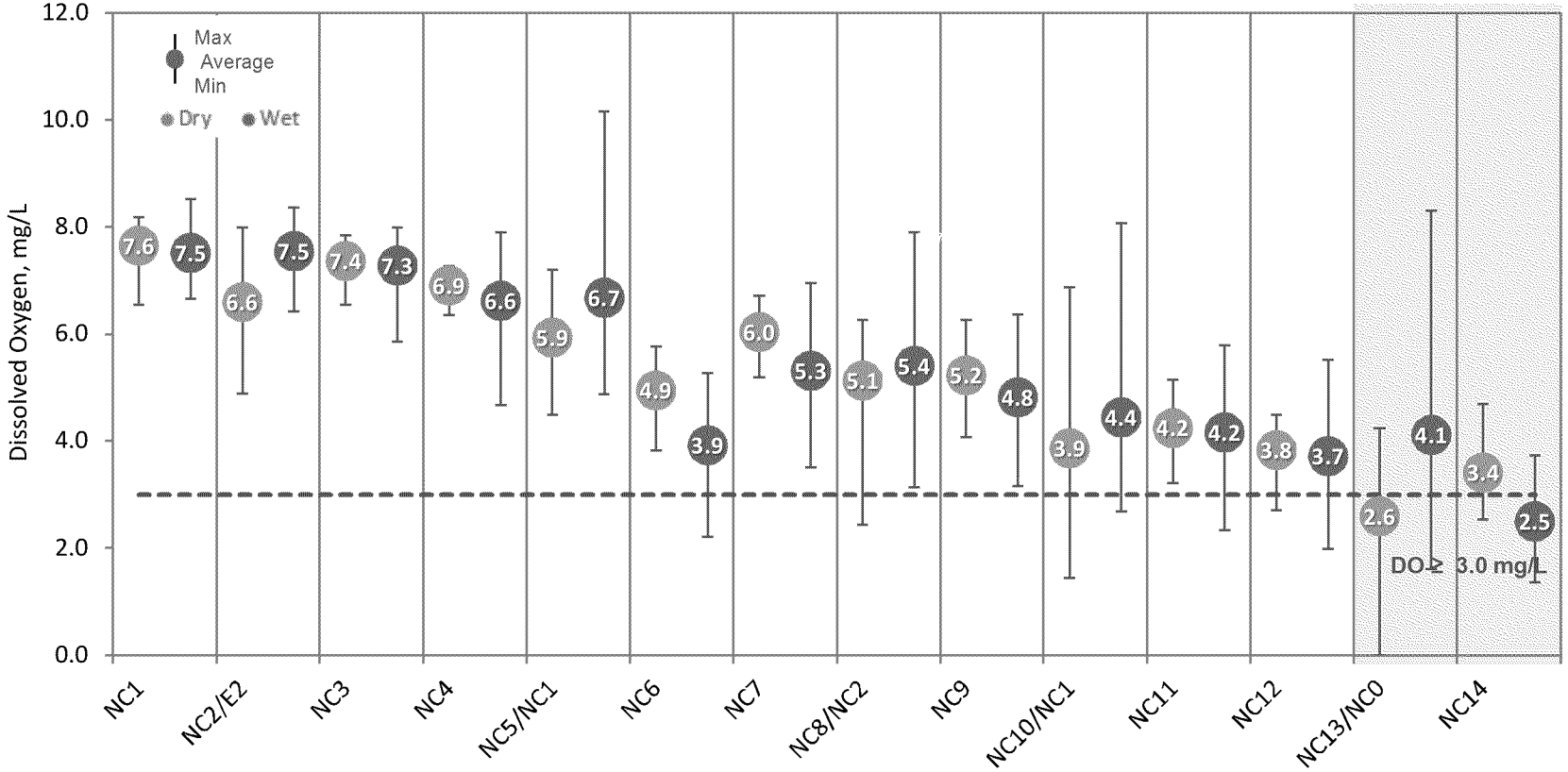
Dissolved Oxygen without Aeration Operating

Sampling Outside of Period of Operation of Aeration System:
January 1 – May 14, 2016
October 1 – November 3, 2016

LTCP2: ~ 8 Dry and 35 Wet Weather Samples per location
HSM: ~ 8 Dry and 8 Wet Weather Samples per location



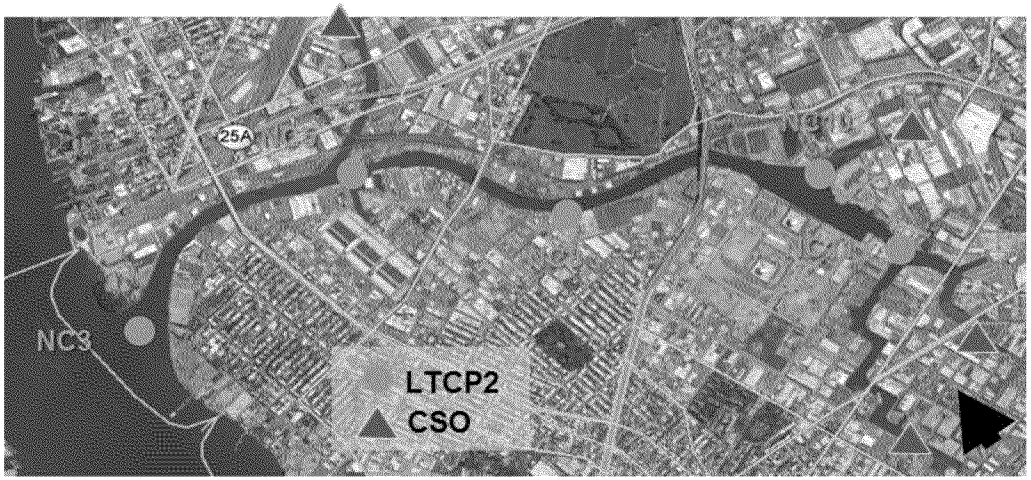
* Note: Aeration on May 15 – Sept 30, 2016

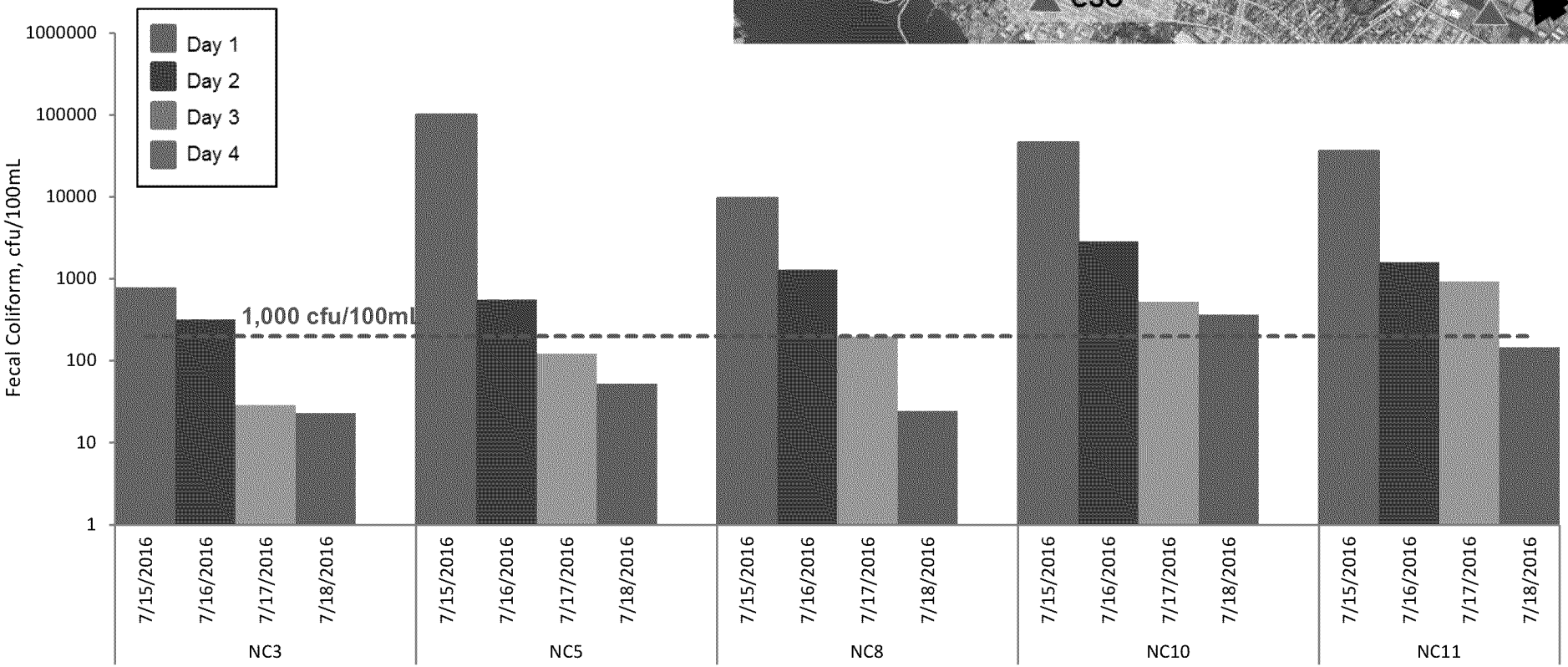


Time to Recover – Fecal Coliform

Event #1

0.50” on 7/14
Duration: 1 hr
RW 7/15 – 7/18

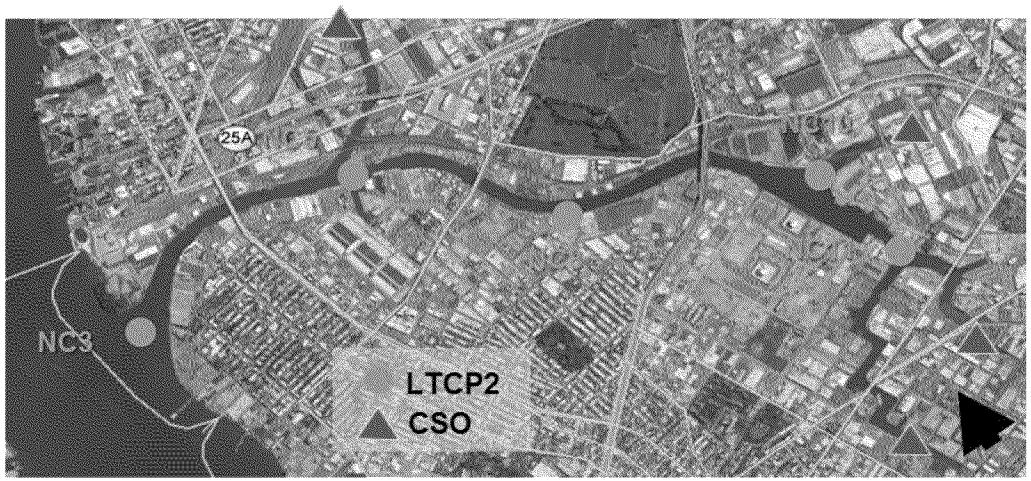


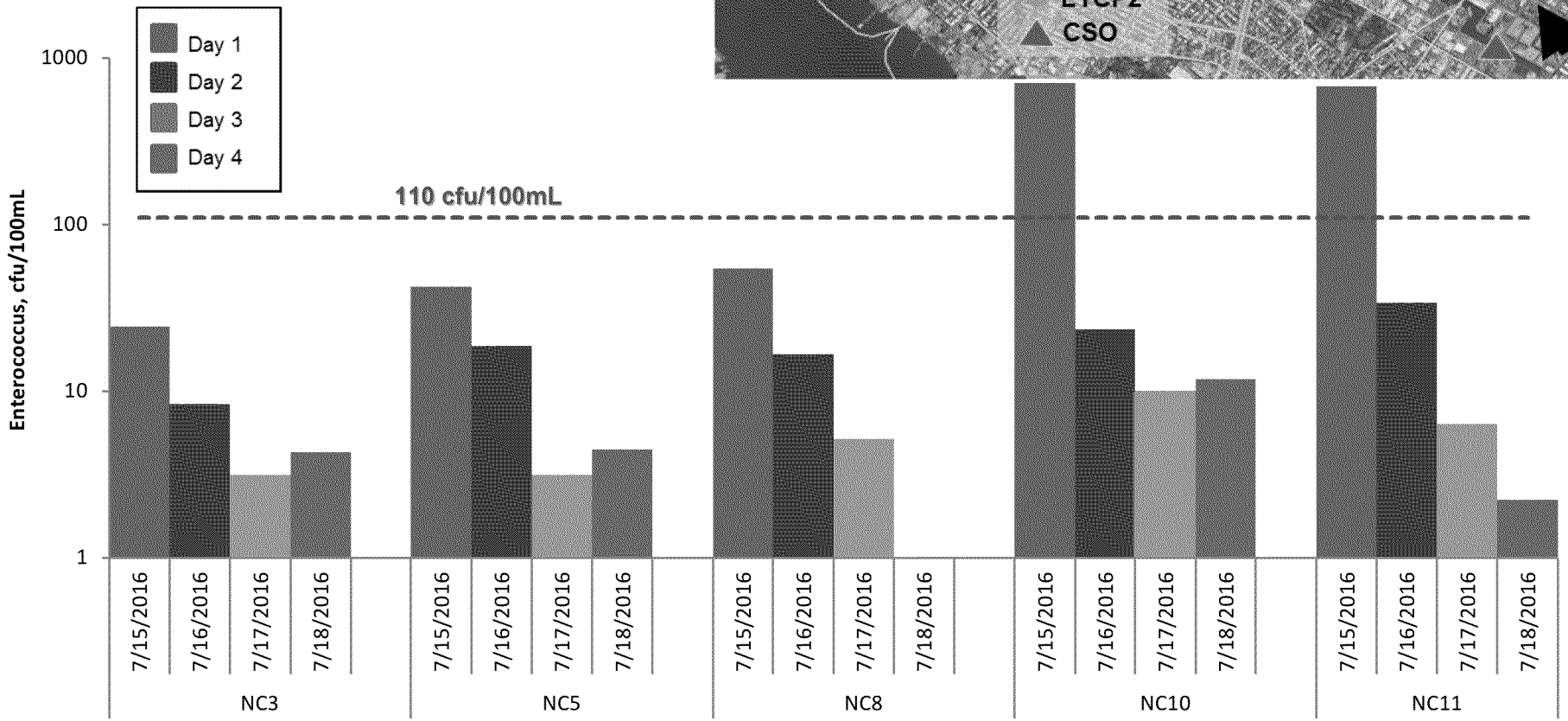


Time to Recover - Enterococci

Event #1

0.50" on 7/14
Duration: 1 hr
RW 7/15 – 7/18

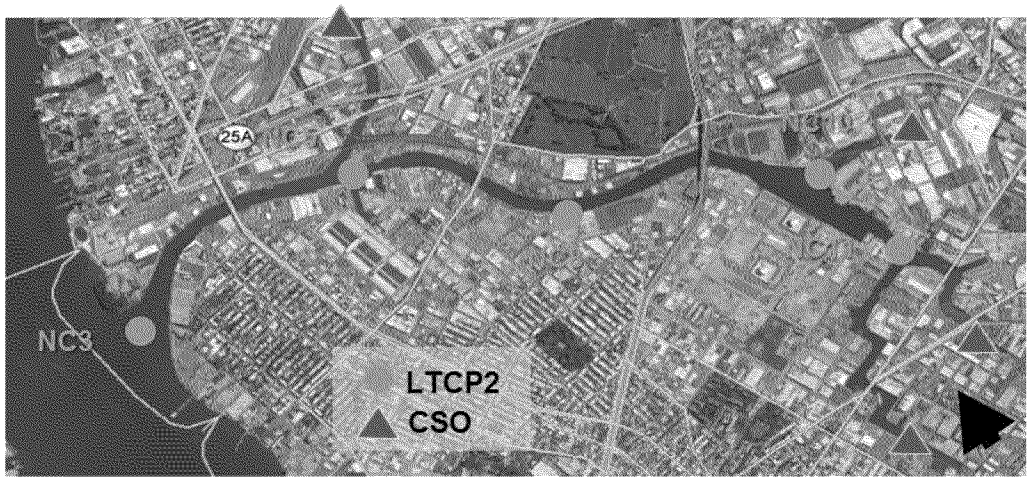


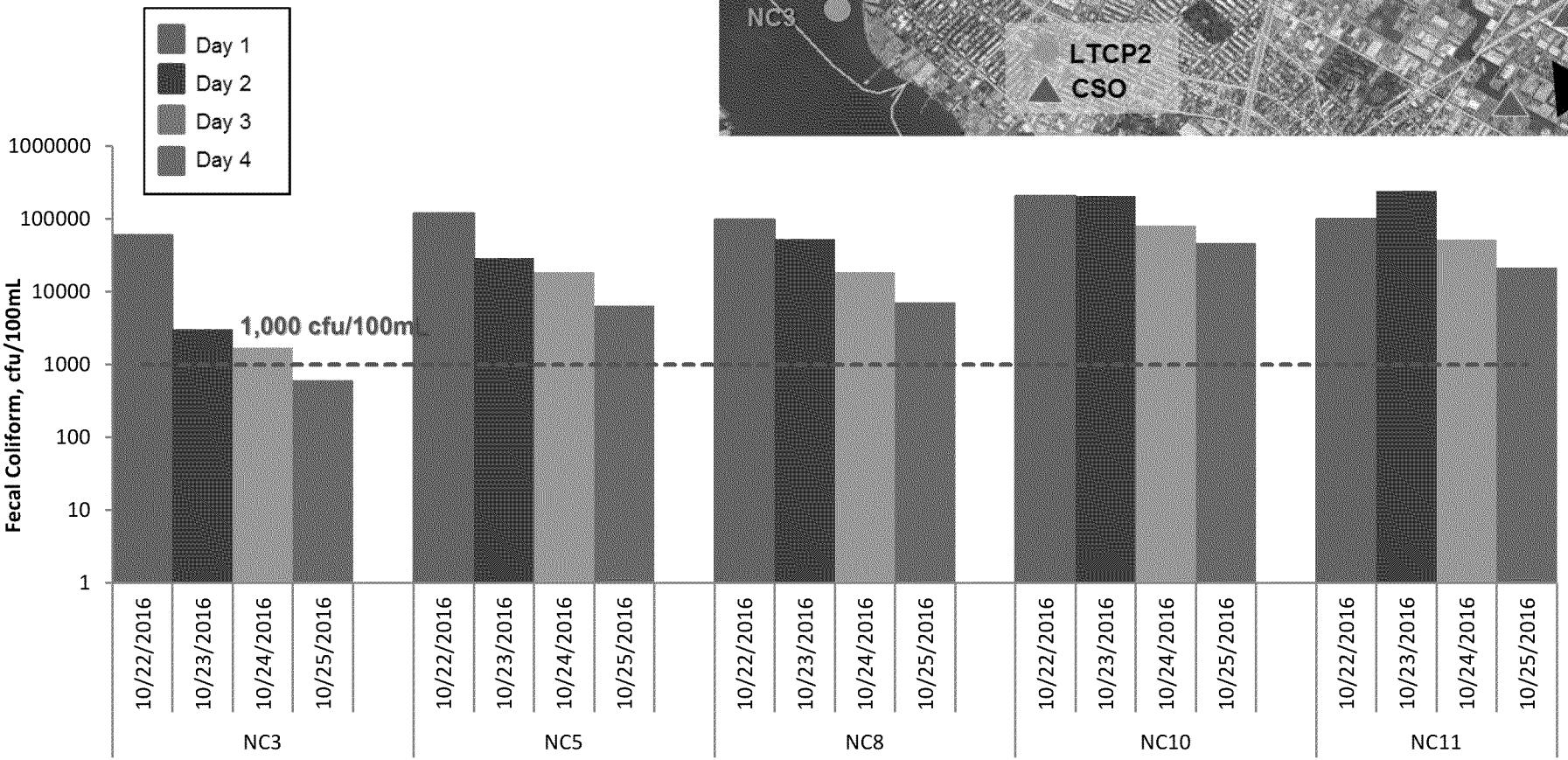


Time to Recover – Fecal Coliform

Event #3

1.81" on 10/21
Duration: 9 hr
RW 10/22-10/25





Time to Recover - Enterococci

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Event #3

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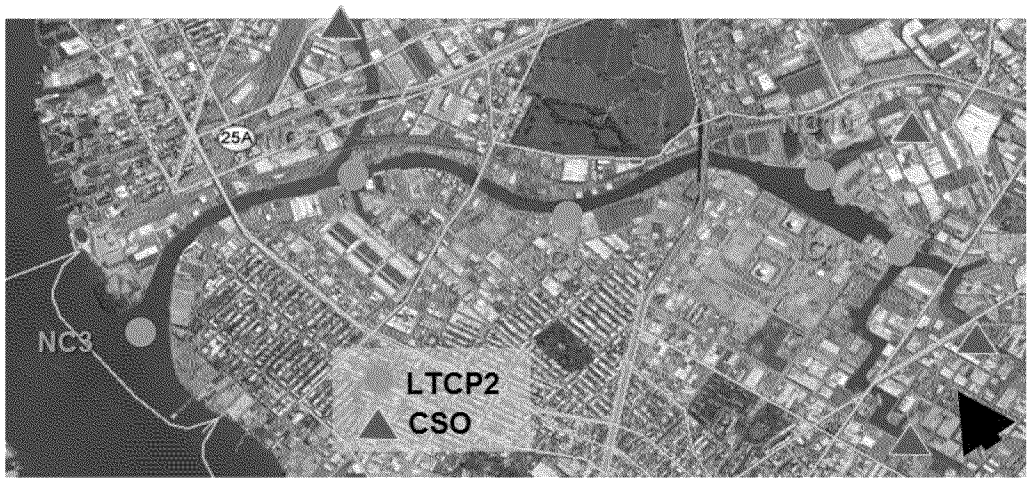
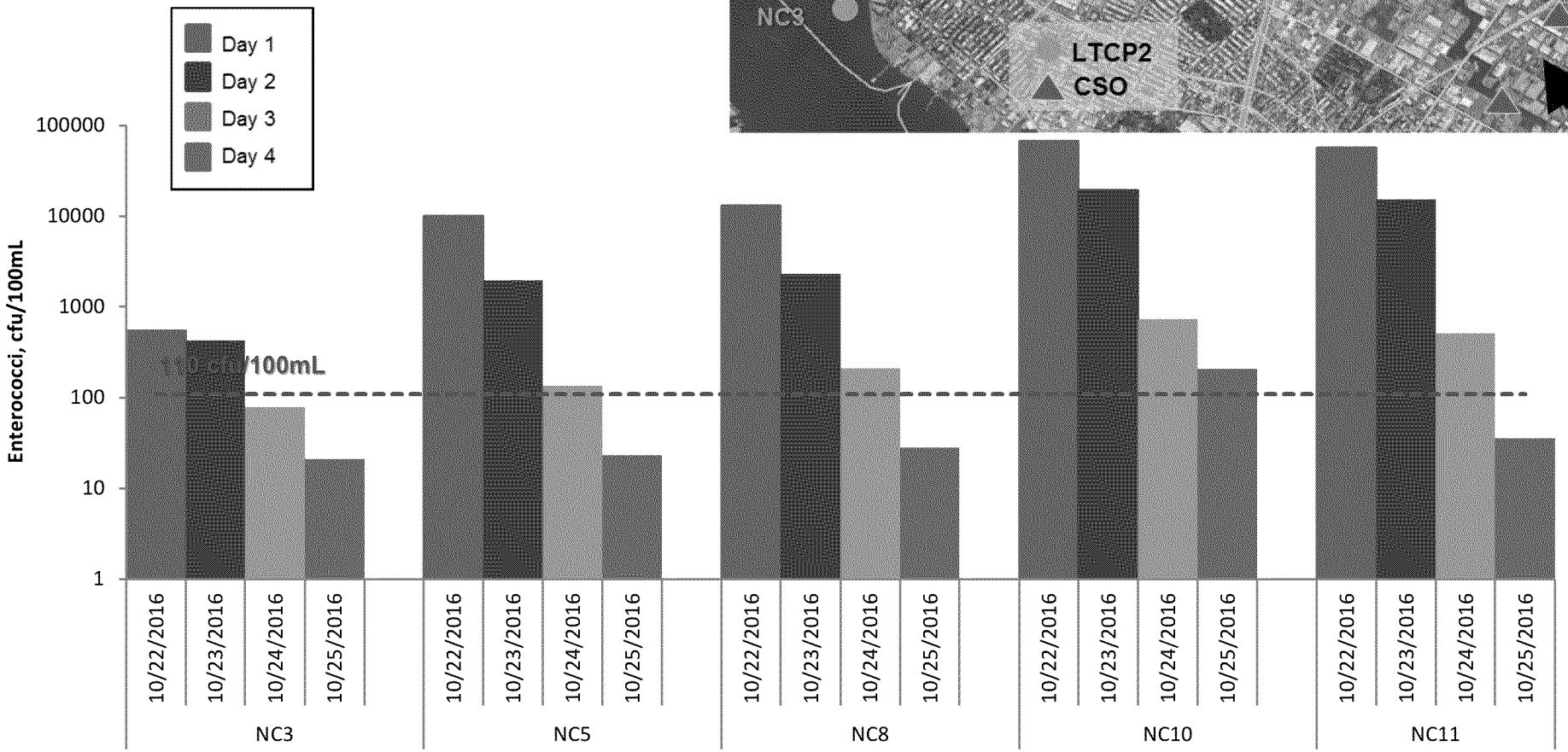
Duration: 9 hr
RW 10/22-10/25





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Water Quality Improvement Projects

Grey and Green Infrastructure

Newtown Creek: CSO Mitigation Projects

	Recommended Project	Construction Cost	Status
1	**Brooklyn/Queens Pump Station at Newtown Creek WWTP**	$300 M	Substantially Completed in 2013
2	**Bending Weirs and Underflow Baffles**	$42 M	In-Construction thru 2017
3	**In-Stream Aeration Projects (4)**	$60 M[1]	In-Construction thru 2020
4	**Built and Planned GI Projects**	$45 M[2]	Ongoing Design and Construction
	Total = $447 M		

1) Cost pending for Maspeth Creek aeration.
2) Cost to date, more GI projects may be pending.

1 Brooklyn/Queens PS at Newtown Creek WWTP

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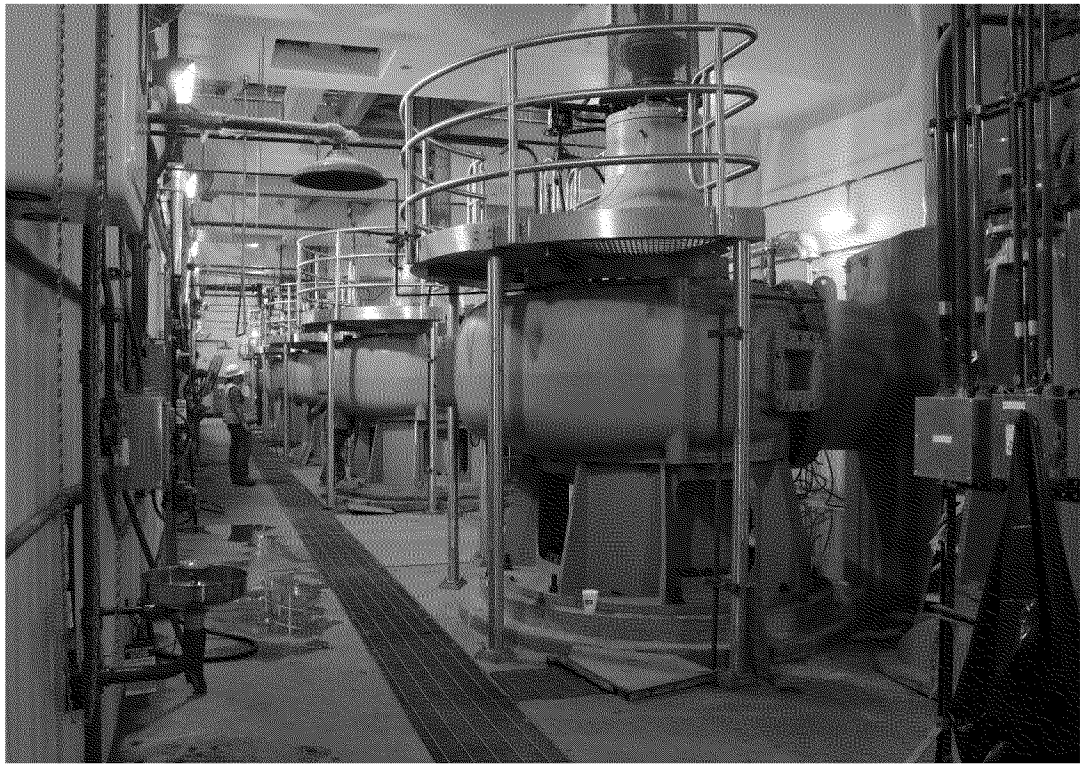
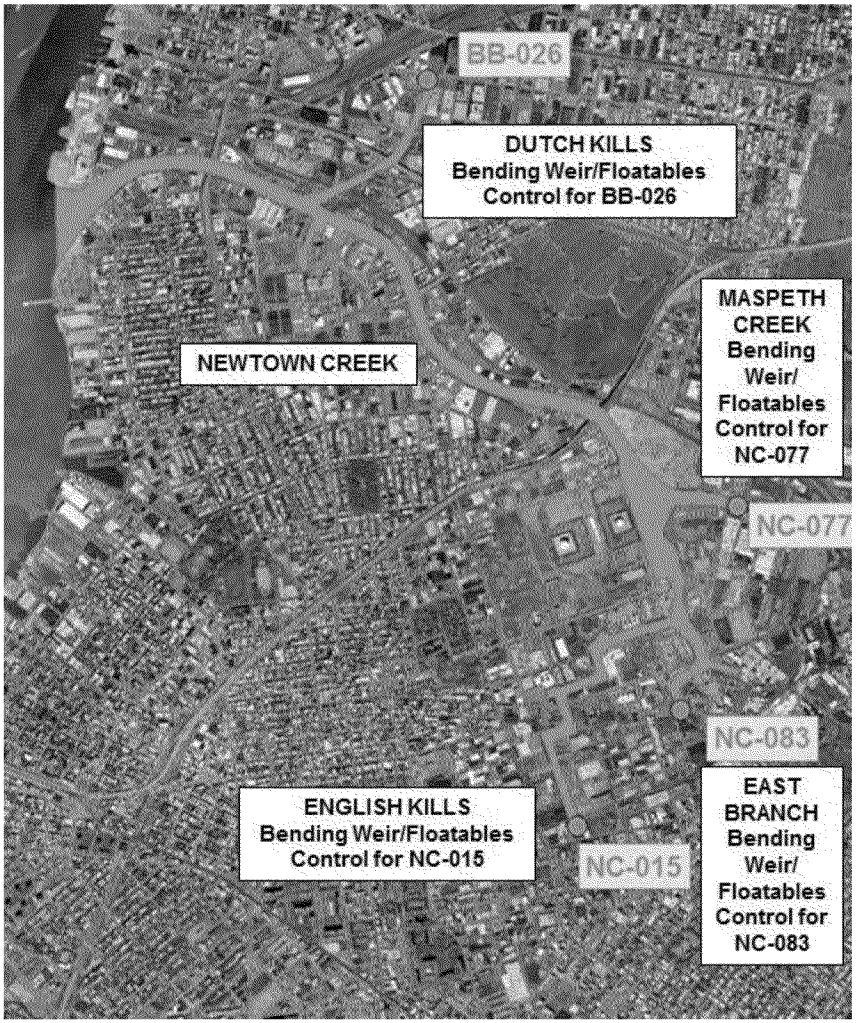
- Continued operation of the Brooklyn/Queens Pumping Station (PS) at NC WWTP
- PS Wet Weather Capacity = 400 MGD
- PS Upgraded in 2013: ~$300 M

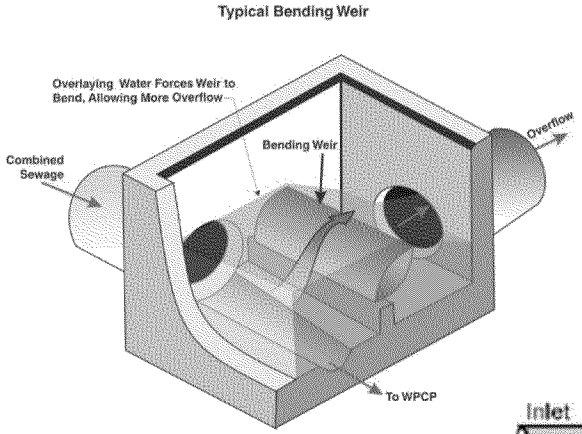
  (includes 5 new MSPs, headworks upgrade, in-line storage facility, odor control)

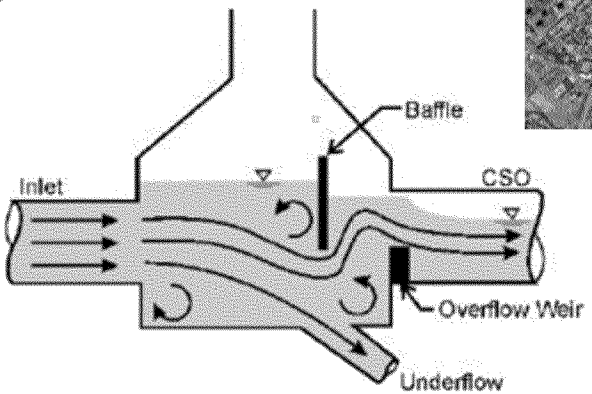


2 Bending Weir and Underflow Baffles

- Construction Cost: $42 M
- Construction Completion: Dec. 2017
- Volume Reduction: 62 MGY
- Provides Floatables Control
- Being installed at 4 locations (●):
  - B-01 (NCB-015), NCQ-01 (NCQ-077), NCB-2 (NCB-083), BB-L4 (BB-026)







3 In-Stream Aeration Projects

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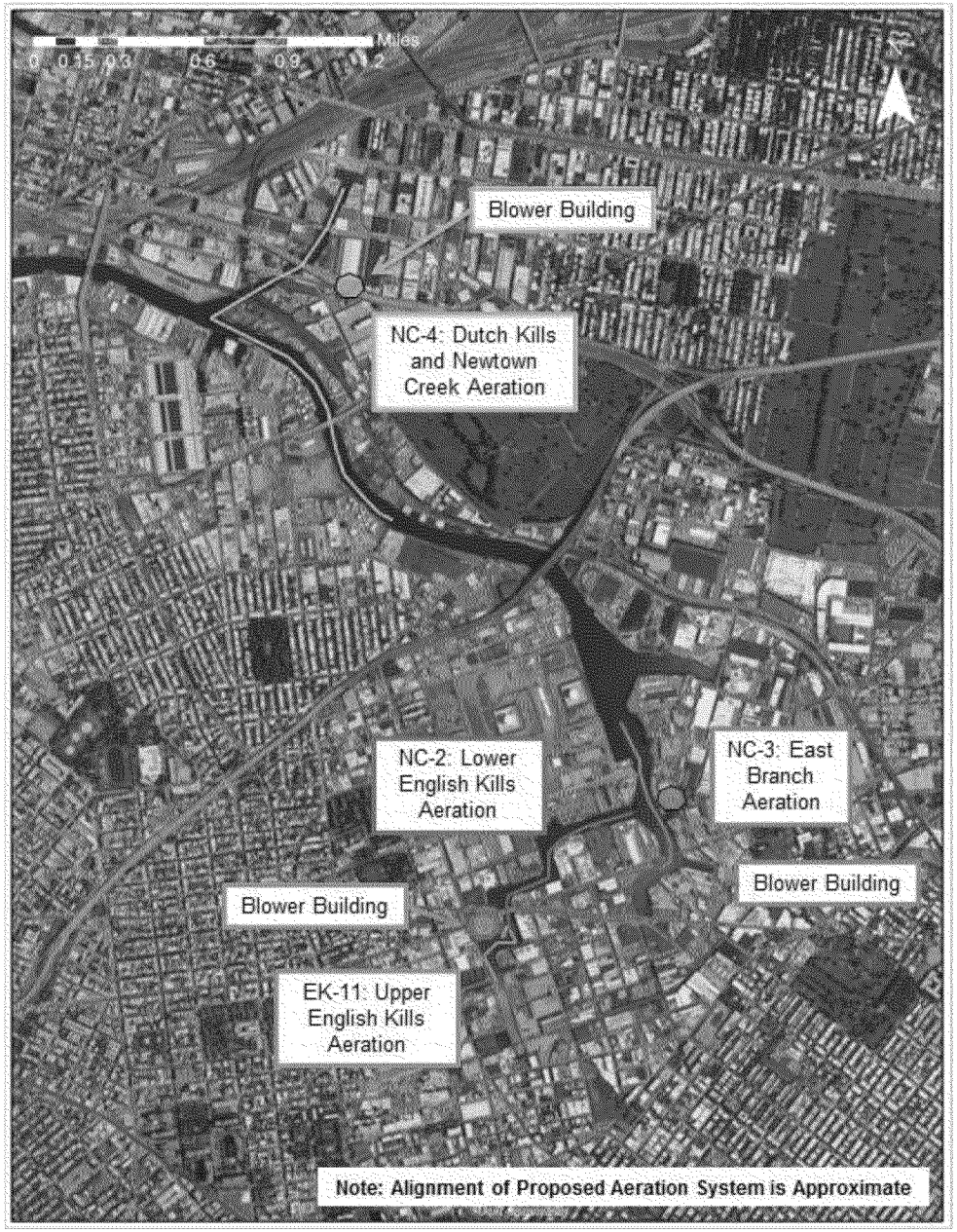
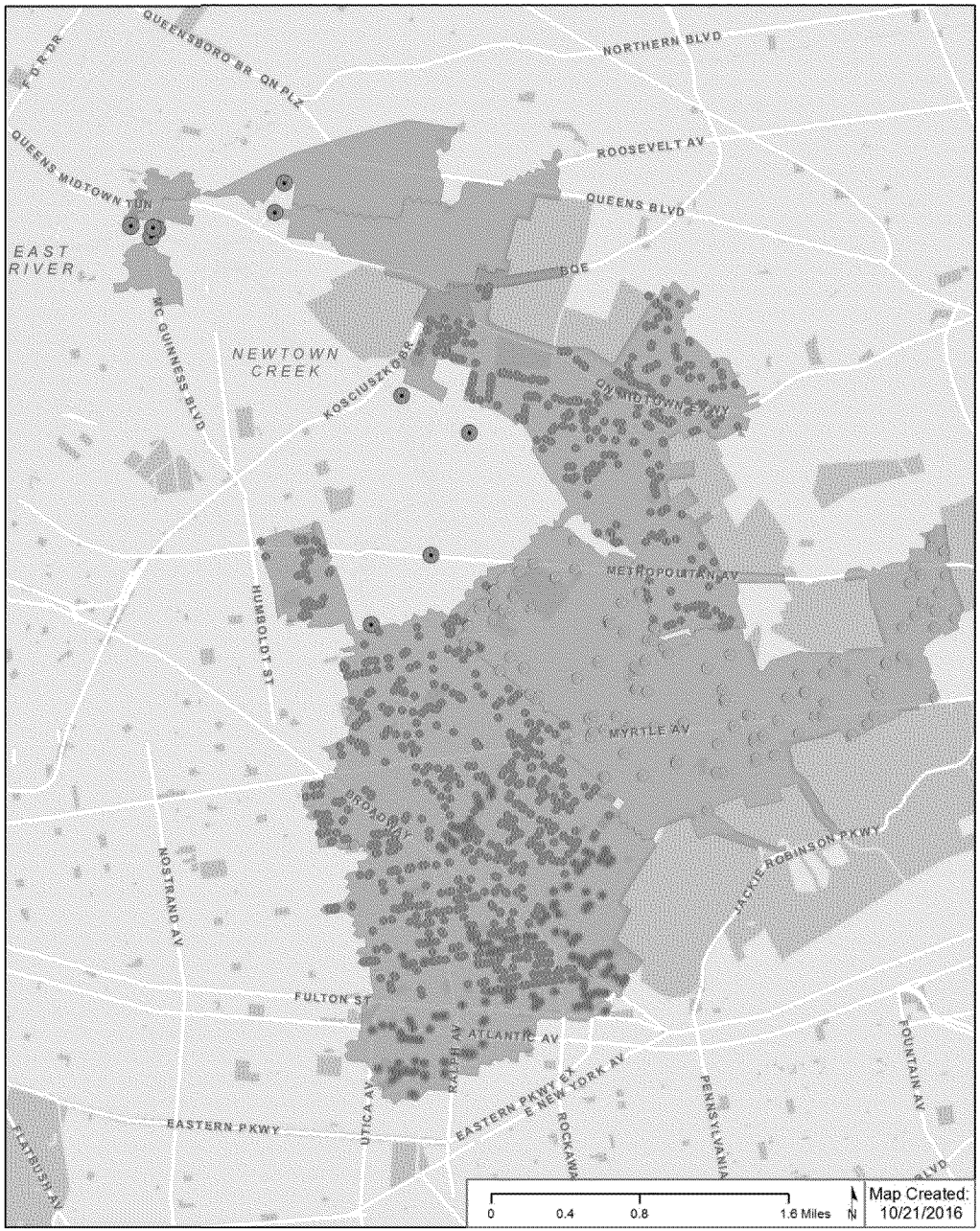
Contract	Aeration Location	Construction Completion	Cost
EK-11	Upper English Kills	Dec. 2008	$9.0 M
CSO-NC-2	Lower English Kills	Jan. 2014	$2.2 M
CSO-NC-3	East Branch	Jun. 2018	$18.0 M
CSO-NC-4	Dutch Kills and Newtown Creek	TBD	$30.8 M



Newtown Creek Built and Planned GI Projects



- More than 1,300 GI assets within streets, parks, and schools
- 98% are ROW Raingardens (aka bioswales)
- Design resources for public onsite only in NCB-015 & NCB-083
- Other areas will be assessed in 2017 with design resources citywide available in 2018

Legend

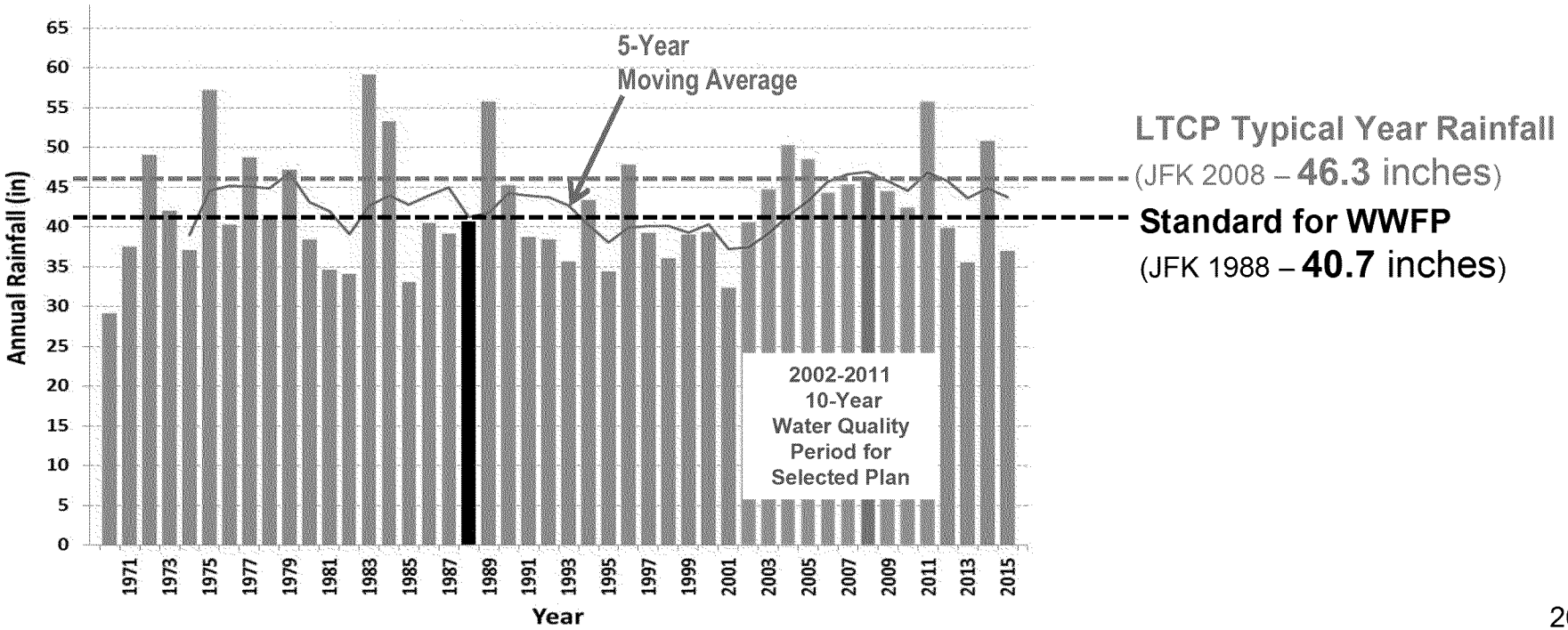
- Waterbodies
- CSO Outfalls
- CSO Outfall Watersheds
- GI Constructed
- GI In Construction
- GI Planned

4

Baseline Modeling and WQS Attainment

Baseline Model Inputs and Assumptions

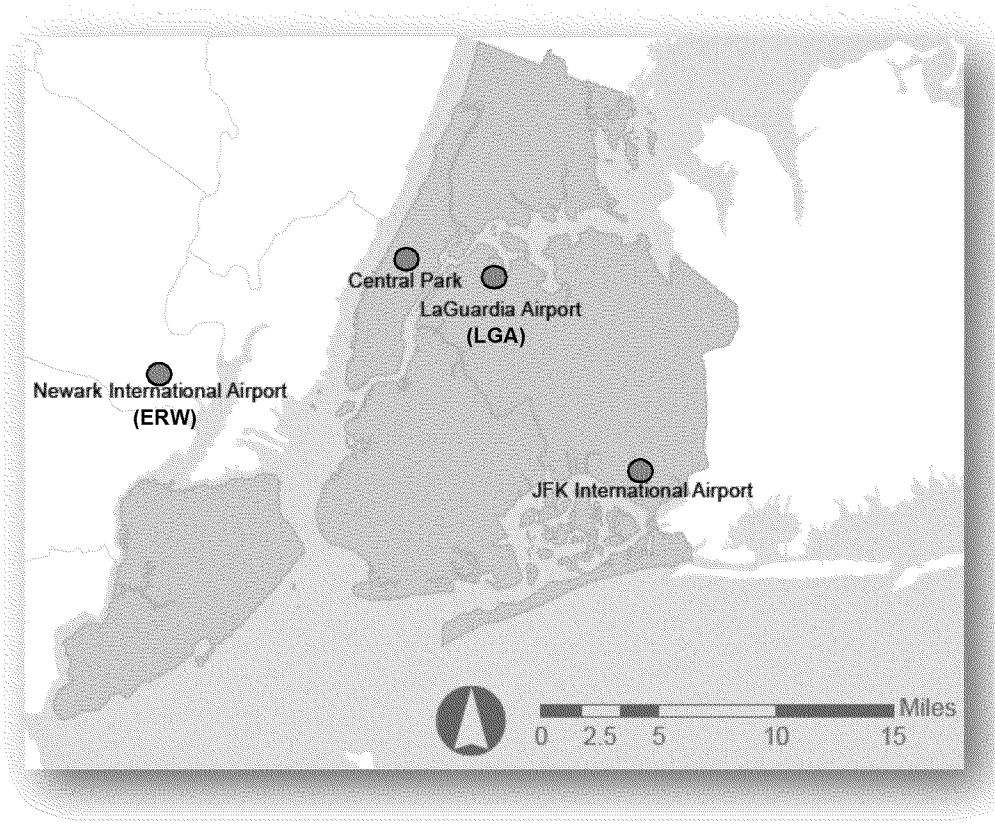
- **Landside Model** calibrated based on flow monitoring data, gauge adjusted radar rainfall data, and satellite flyover impervious data
- **Water Quality Model** calibrated with Harbor Survey and LTCP sampling data
- Baseline modeling inputs and assumptions include:
  - Committed CSO and BNR projects
  - 2040 sanitary flows and loads
  - Use of "Typical Year Rainfall" for Alternative Analysis per EPACSO Policy (JFK 2008)
  - JFK 10-yr data (2001 to 2011) for baseline and selected alternatives



Rainfall Selection for Model Updates

Evaluated a comprehensive range of rainfall data:

- Historical data range: **42 years** from 1969 to 2010
- Four representative rainfall gauges: Central Park, LGA, JFK, and ERW
- Selected **2008 JFK rainfall** as the most representative of average annual rainfall across all four gauges



LTCP Baseline Conditions Modeling

1. Continued operation of Brooklyn / Queens PS at NC WWTP at up to 400 MGD during wet weather
2. Construction of Bending Weirs and Underflow Baffles at 4 Locations
3. Construction of In-Stream Aeration

WWFP Plan ($402 M)

+

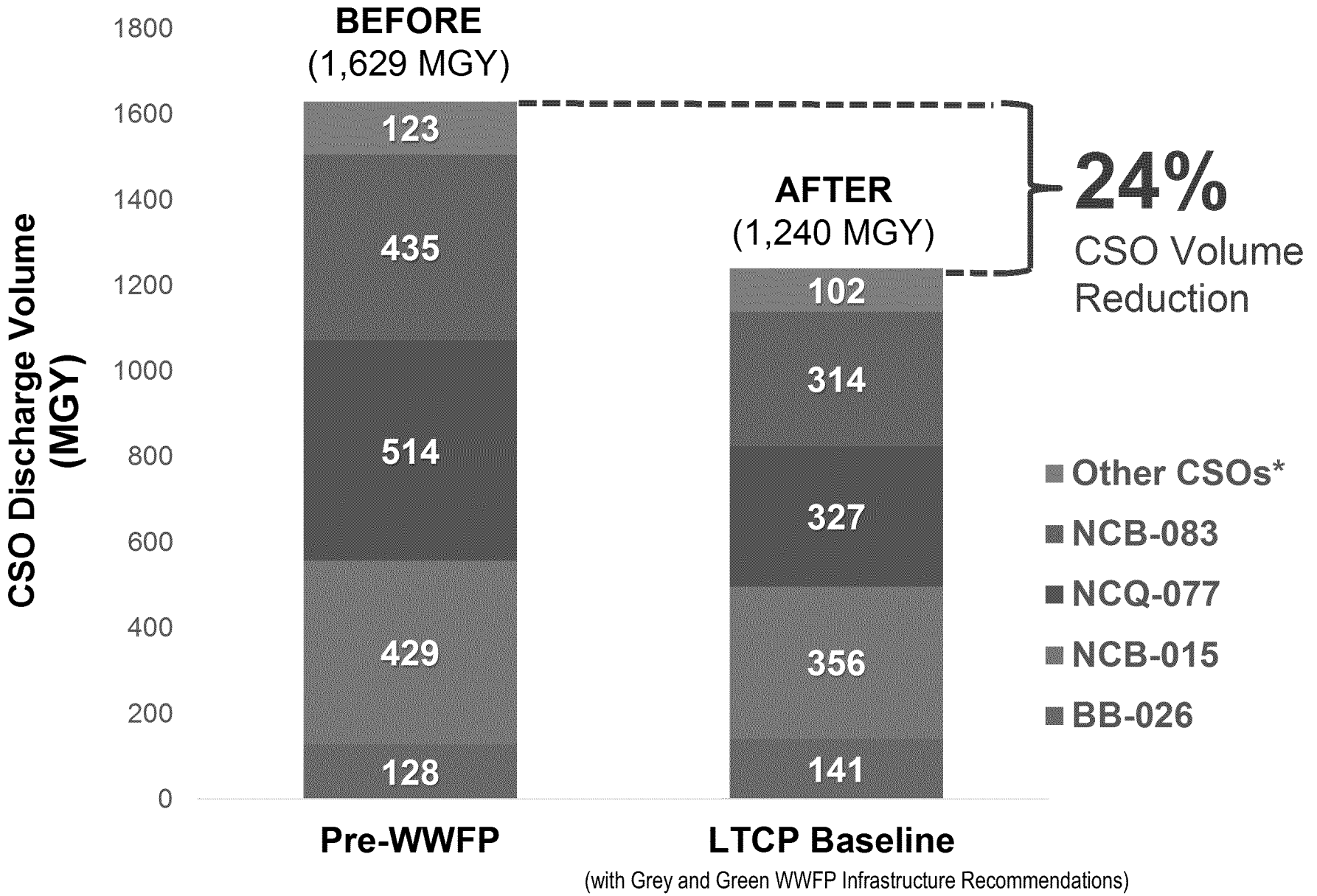
4. Committed Green Infrastructure in Newtown Creek watershed

3.2% Green Infrastructure ($45 M for 110 acres)[1]

LTCP Baseline ≈1.2 BGY CSO

1) Cost to date, more GI projects may be pending.

Newtown Creek: Modeled Baseline CSO Volumes

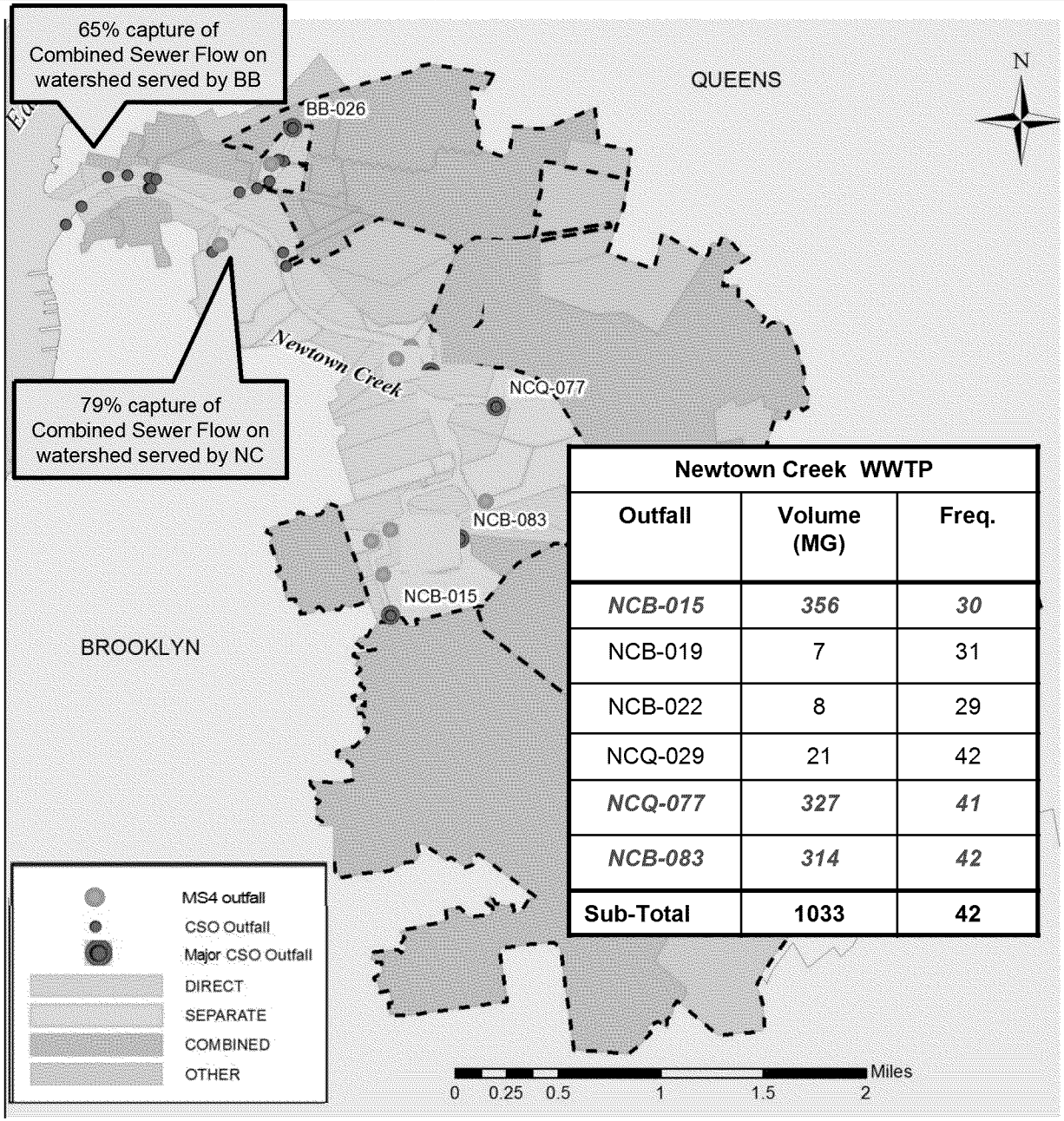


*Other Newtown Creek CSOs include: BB-009, BB-010, BB-011, BB-013, BB-040, BB-042, NCB-019, NCB-022, NCQ-029

Newtown Creek CSO Volume

Bowery Bay WWTP (LL Interceptor)		
Outfall	**Volume (MG)**	**Freq.**
BB-009	49	35
BB-010	1	7
BB-011	2	14
BB-013	17	32
BB-026	***141***	***39***
BB-040	1	7
BB-042	2	23
Sub-Total	**213**	**39**

- **Annual LTCP baseline** (WWFP plan + GI) CSO AAOV = **1,246 MG**.
- **Four major outfalls** account for **92%** of CSO volume
- **432 MG Direct Drainage and non-MS4 Stormwater**
- **482 MG MS4 Stormwater**



Newtown Creek WWTP		
Outfall	**Volume (MG)**	**Freq.**
NCB-015	***356***	***30***
NCB-019	7	31
NCB-022	8	29
NCQ-029	21	42
NCQ-077	***327***	***41***
NCB-083	***314***	***42***
Sub-Total	**1033**	**42**

5

CSO Control Alternatives and Siting

Newtown Creek Alternatives Toolbox

INCREASING COMPLEXITY

INCREASING COST

Source Control	Existing GI	Additional GI	High Level Sewer Separation		
System Optimization	Fixed Weir	Parallel Interceptor / Sewer	Bending Weirs Control Gates	Pump Station Optimization	Pump Station Expansion
CSO Relocation	Gravity Flow Tipping to Other Watersheds	Pumping Station Modification	Flow Tipping with Conduit/Tunnel and Pumping		
Water Quality / Ecological Enhancement	Floatables Control	Environmental Restoration	Mechanical aeration	Flushing Tunnel	
Treatment *Satellite:*	Outfall Disinfection	Retention Treatment Basin (RTB)		High Rate Clarification (HRC)	
Centralized:	WWTP Expansion				
Storage	In-System	Shaft	Tank	Tunnel	

Completed or underway

Newtown Creek Alternatives Toolbox Results

INCREASING COMPLEXITY

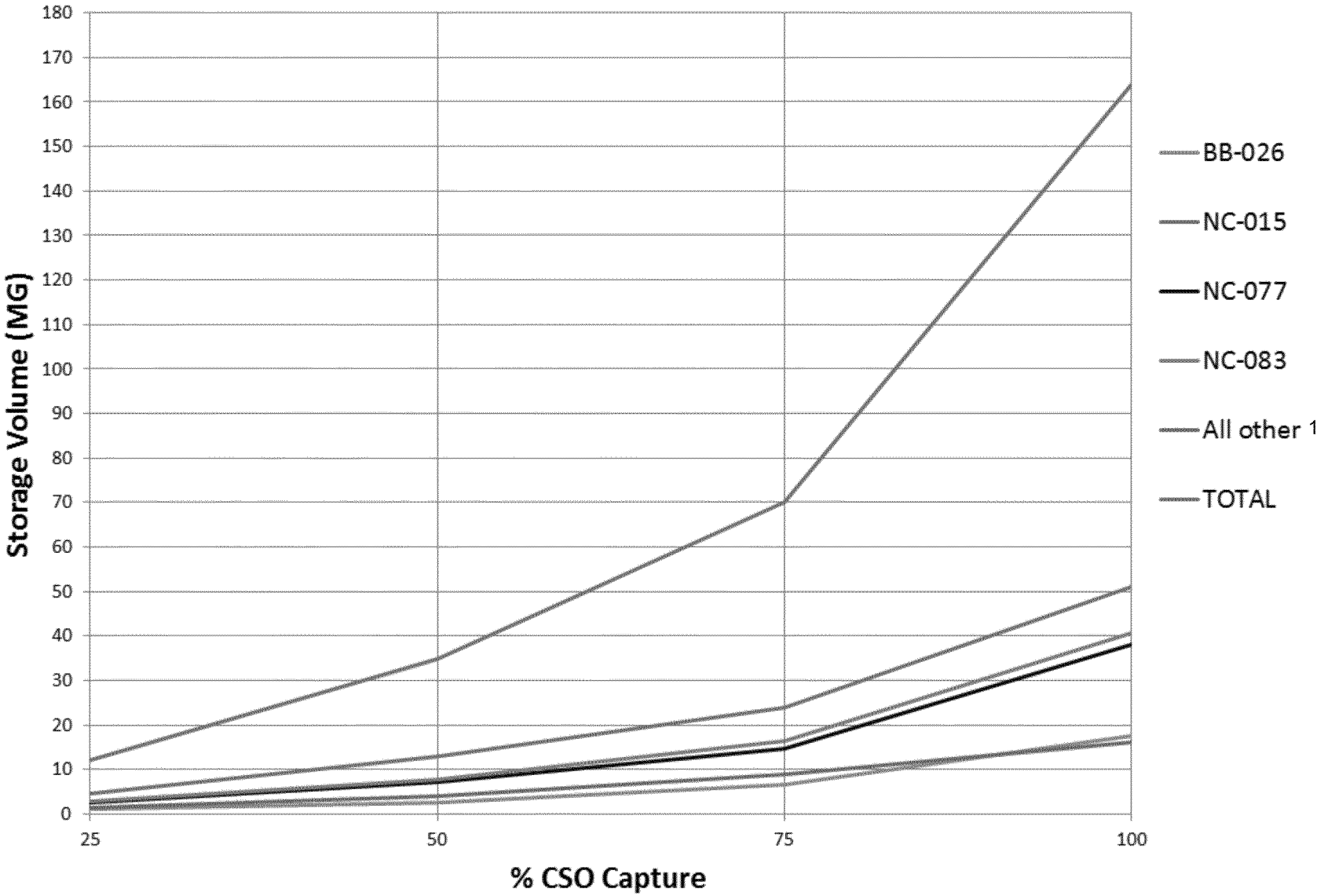
INCREASING COST

Source Control	Existing GI	Additional GI	High Level Separation		
System Optimization	Fixed Weir	Parallel Interceptor / Sewer	Bending Weirs Control Gates	Pump Station Optimization	Pump Station Expansion
CSO Relocation	Gravity Flow Tipping to Other Watersheds	Pump Station Mechanical	Flow Tipping with Conduit/Tunnel and Pumping		
Water Quality / Ecological Enhancement	Floatables Control	Environmental Restoration	Mechanical aeration	Flushing Tunnel	
Treatment *Satellite:*	Outfall Disinfection	Retention Treatment Basin (RTB)		High Rate Clarification (HRC)	
Centralized:	WWTP Expansion				
Storage	In-System	Shaft	Tank	Tunnel	

Completed or underway

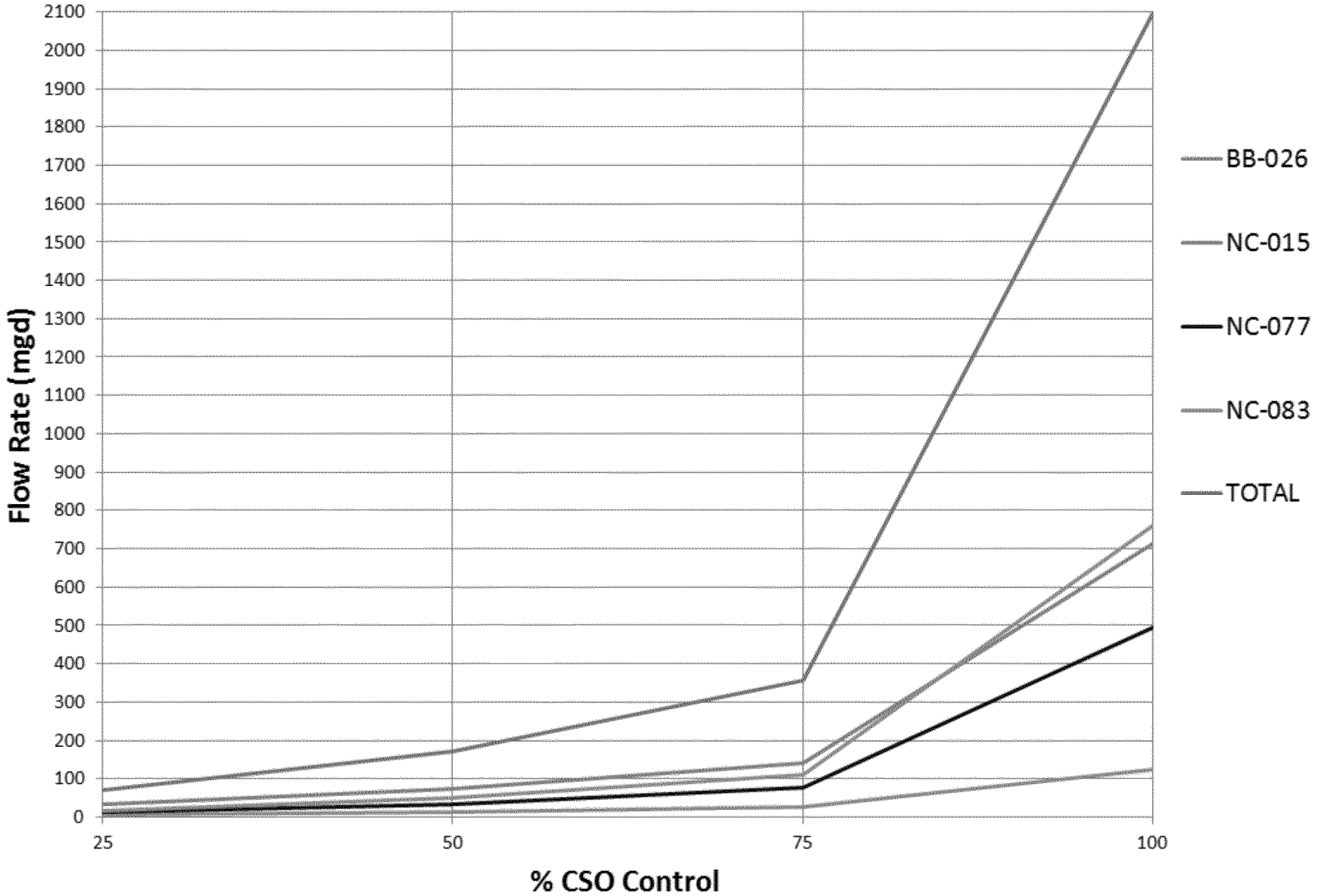
CSO Controls further evaluated

Required Storage Volumes

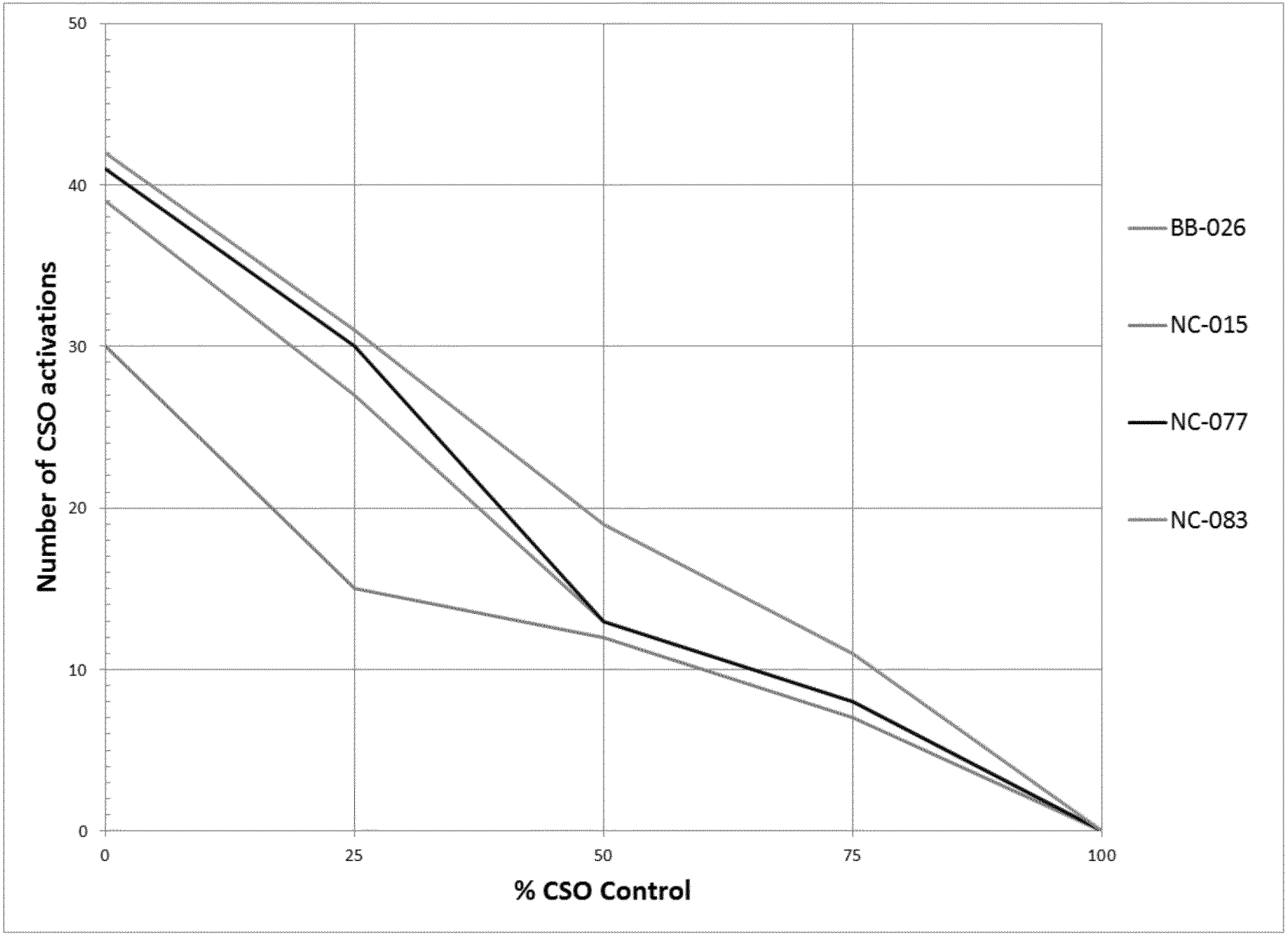


[1] Includes 6 outfalls from Bowery Bay and 3 outfalls from Newtown Creek.

Peak Flow Rate for Targeted % Volume (MGD)



Annual CSO Activation Frequency



Alternatives for the Four Largest Outfalls

Outfall	Alternatives Evaluated						
	Disinfection	Retention Treatment Basin	High Rate Clarification	Vertical Storage Shafts	Storage Tanks	In-line storage	Tunnel
NCB-015 English Kills	(Basin) ✓	✓	X (2)	✓	✓	X (1)	✓
NCB-083 East Branch	(Outfall & On land Basin) ✓	✓	X (2)	✓	✓	✓	✓
NCQ-077 Maspeth Creek	(Outfall & On land Basin) ✓	✓	X (2)	✓	✓	✓	✓
BB-026 Dutch Kills	(Basin) ✓	✓	X (2)	✓	✓	X (1)	✓

1) Existing outfall not long enough to provide meaningful storage volume.
2) Insufficient space to provide disinfection contact time for HRC.

Parcels Map

Parcel Occupied With Building

Vacant Parcel (no Building)

Outfall NC-015: English Kills (Parcel Options)

Outfall NC-015 Parcel Information		
	Land Use	**Area (ac)**
Parcel 15-1	Vacant	0.7

- **No vacant parcels identified that would provide land area needed for any of the stand-alone alternatives. Parcel 15-1 can be used as a drop/retrieval shaft site for tunnel alternatives.**

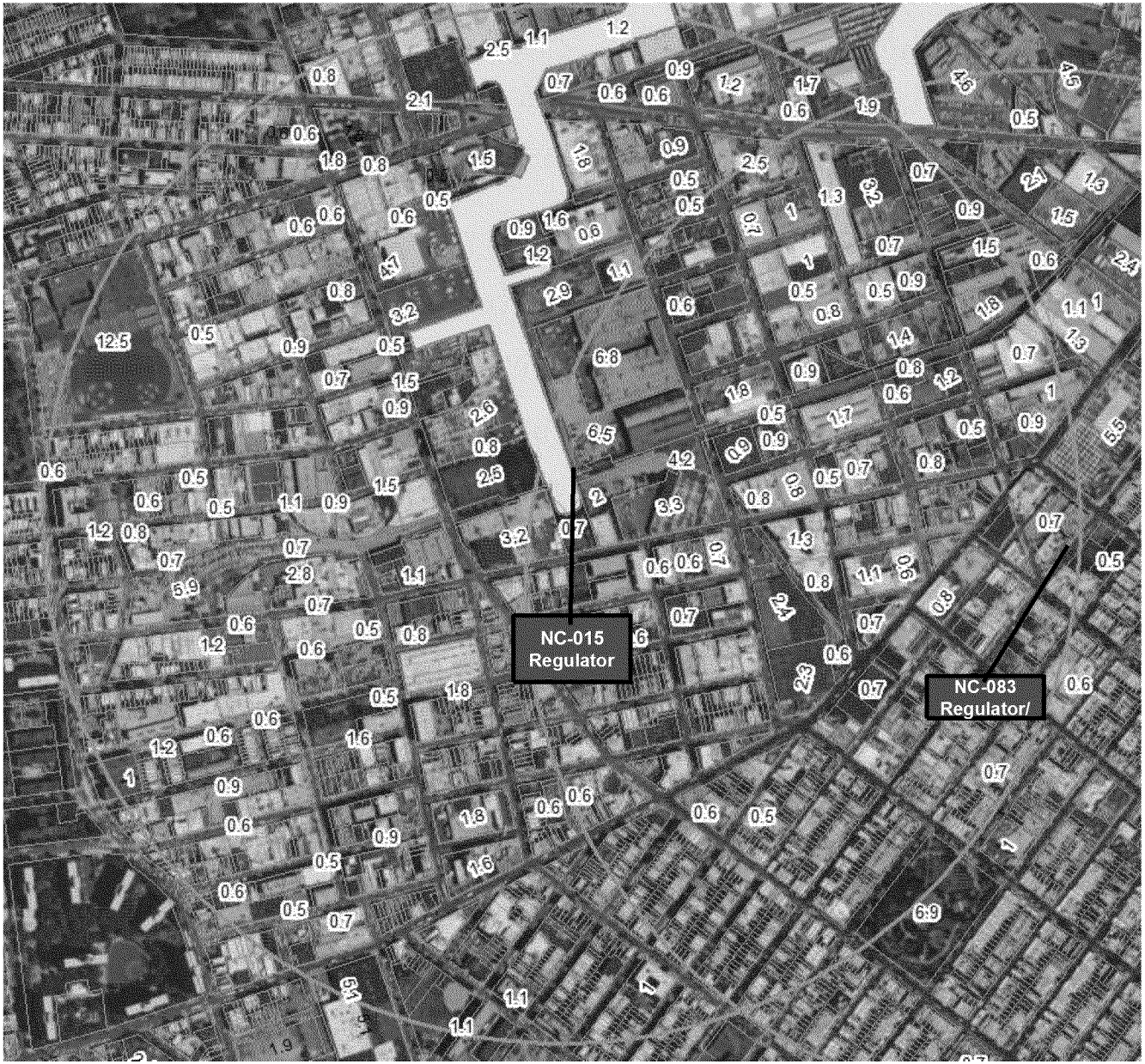
NC-015 – Potential Occupied parcel for CSO Storage

- **Maximum % control limited by largest single parcel within ½ mile radius.**
- **Dewatering conveyance is not a limiting factor**

	Dimension of tank with setback	
Max % Control	W (ft)	L(ft)
75	461	822

NC-015 Outfall – Detailed View

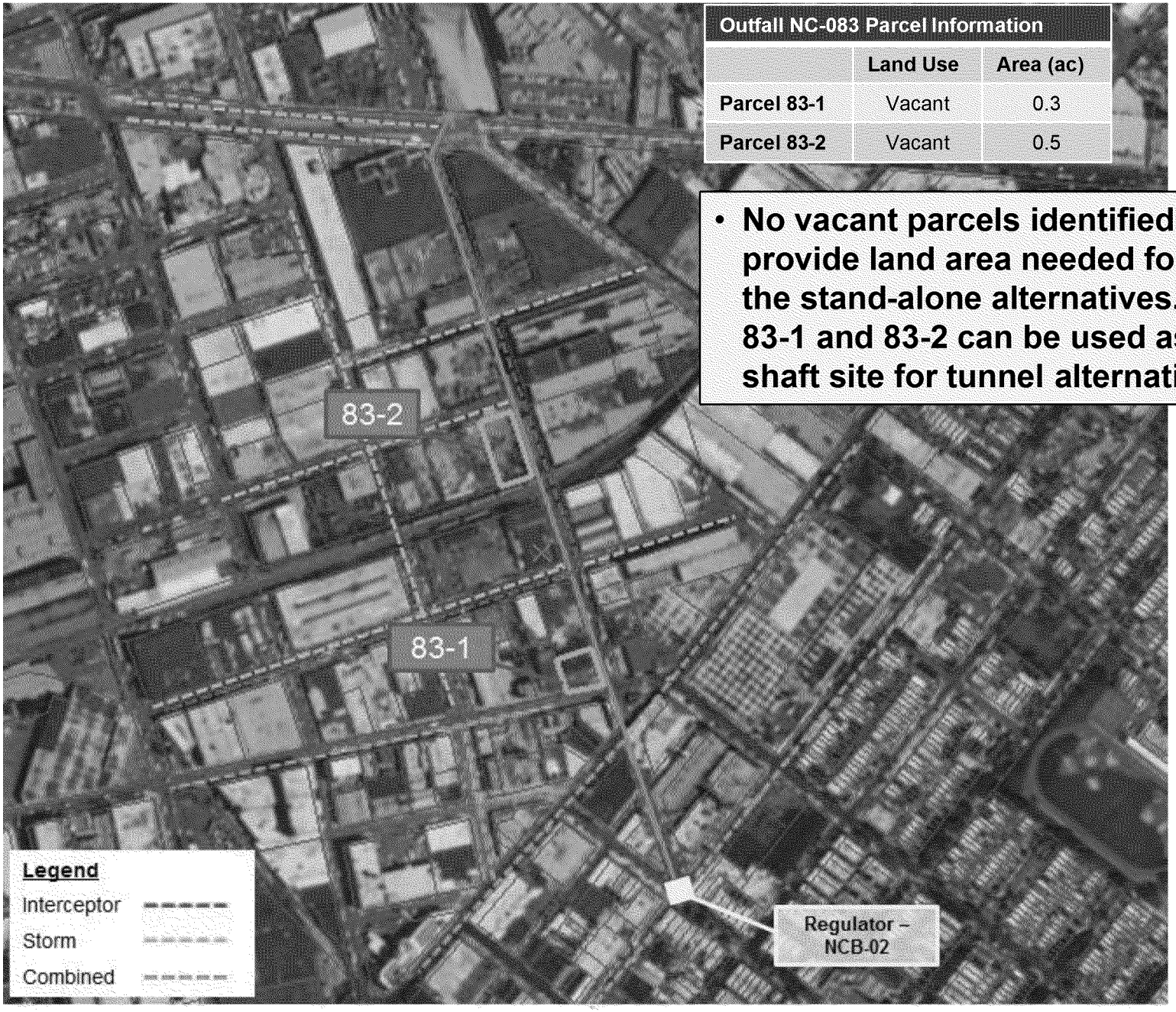
Parcels larger than 0.5 acres within 1/2 mile radius from regulator



% Annual Control	Storage Tank	
	Required Area[1] (acres)	# of Identified Parcels[2]
25	1.9	18
50	3.6	6
75	5.3	3
100	9.3	0

(1) Includes 50 ft. setback.
(2) Cemeteries, schools and rail yards not included.

Outfall NC-083: East Branch (Parcel Options)



Outfall NC-083 Parcel Information		
	Land Use	Area (ac)
Parcel 83-1	Vacant	0.3
Parcel 83-2	Vacant	0.5

- **No vacant parcels identified that would provide land area needed for any of the stand-alone alternatives. Parcels 83-1 and 83-2 can be used as a drop shaft site for tunnel alternatives.**

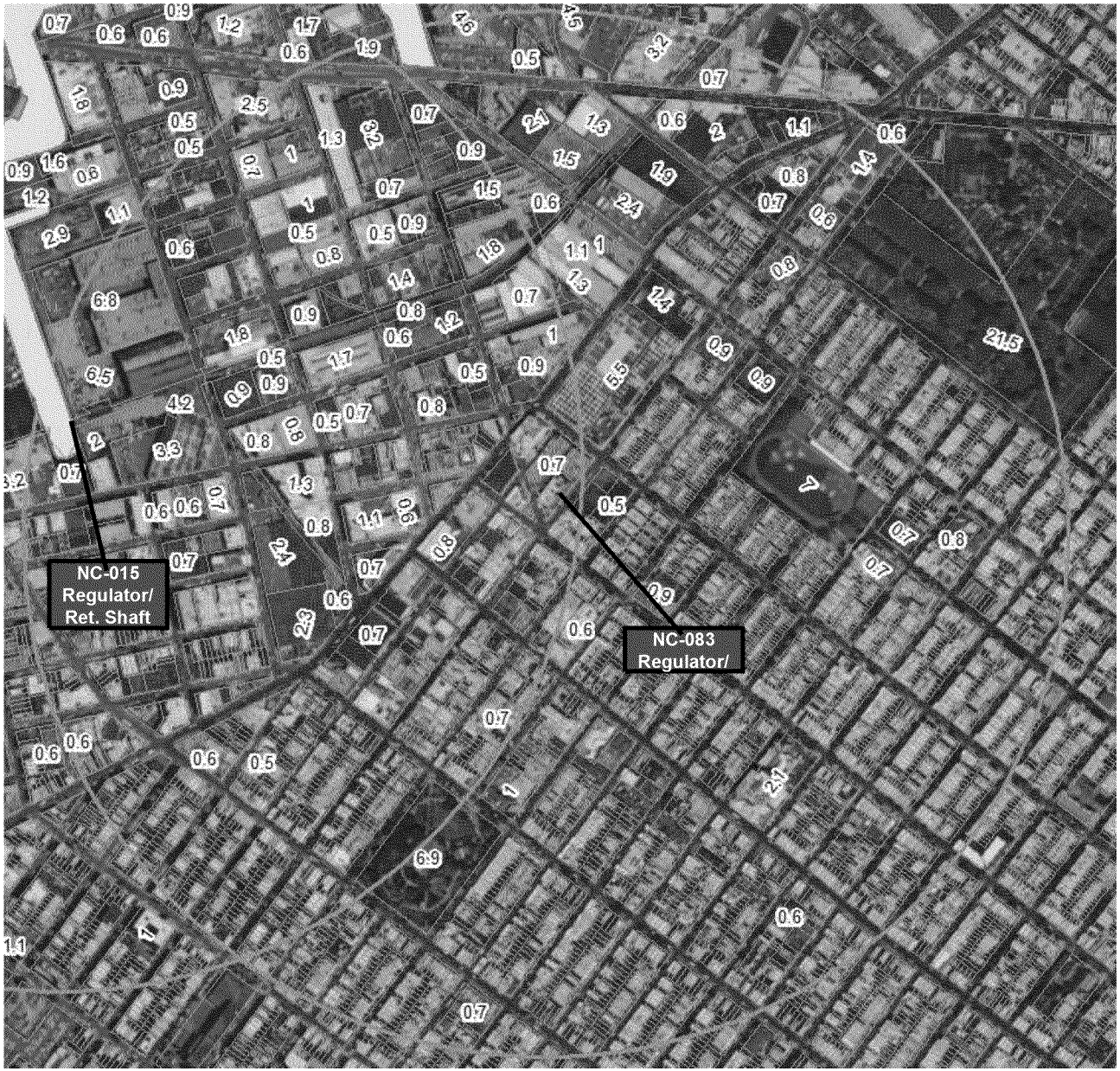
NC-083 – Potential Occupied parcel for CSO Storage

- **Maximum % control limited by largest single parcel within ½ mile radius.**
- **Dewatering conveyance is not a limiting factor**

	Dimension of tank with setback	
Max % Control	W (ft)	L(ft)
75	426	752

NC-083 Outfall – Detailed View

Parcels larger than 0.5 acres within 1/2 mile radius from regulator



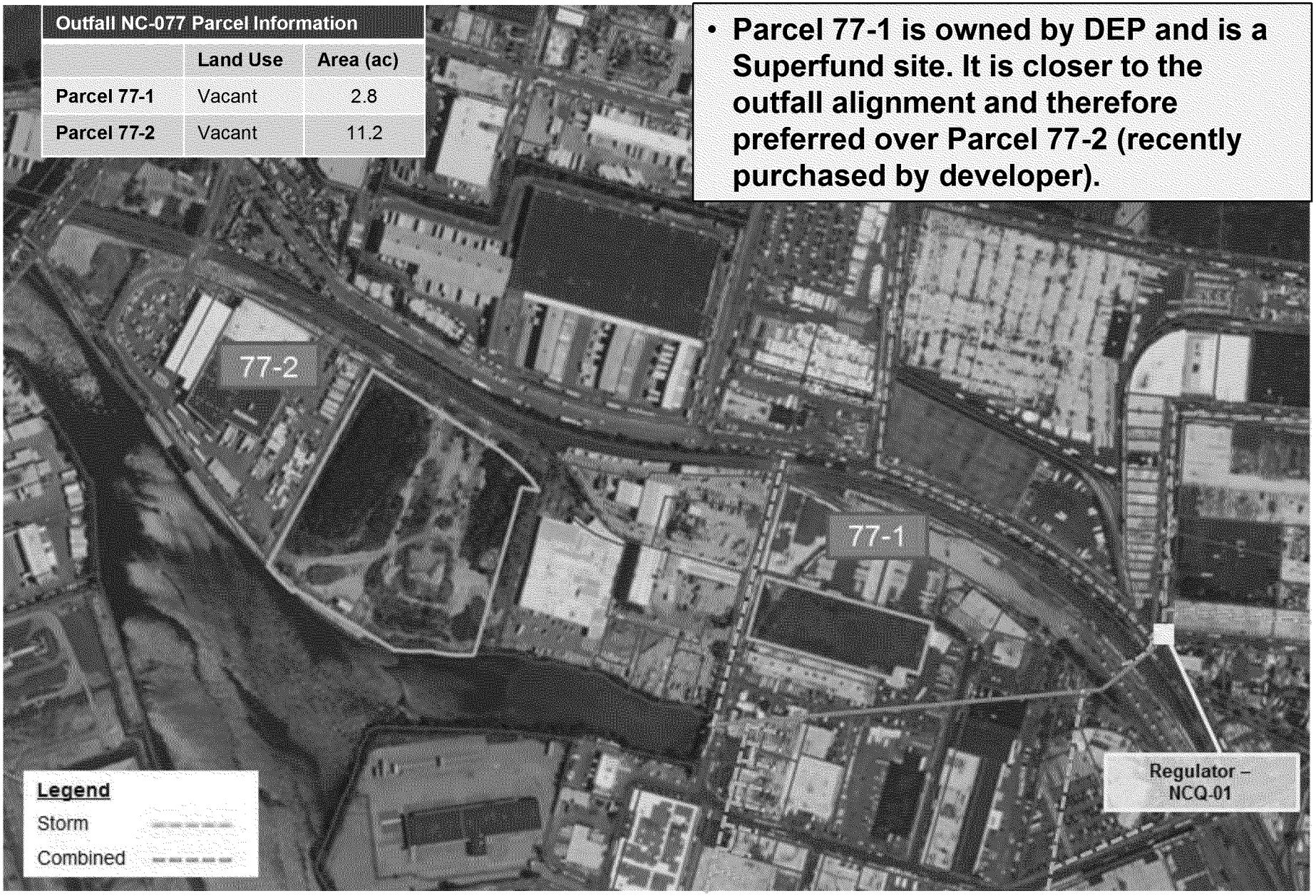
% Annual Control	Storage Tank	
	Required Area[1] (acres)	# of Identified Parcels[2]
25	1.5	17
50	2.6	7
75	4.1	4
100	7.9	0

(1) Includes 50 ft. setback.
(2) Cemeteries, schools and rail yards not included.

Outfall NC-077: Maspeth Creek (Parcel Options)

Outfall NC-077 Parcel Information		
	Land Use	Area (ac)
Parcel 77-1	Vacant	2.8
Parcel 77-2	Vacant	11.2

- **Parcel 77-1 is owned by DEP and is a Superfund site. It is closer to the outfall alignment and therefore preferred over Parcel 77-2 (recently purchased by developer).**



Outfall NC-077: Parcel 77-1 (Land Options)

Assumed 50-ft setback for all alternatives (shown as dashed perimeter).

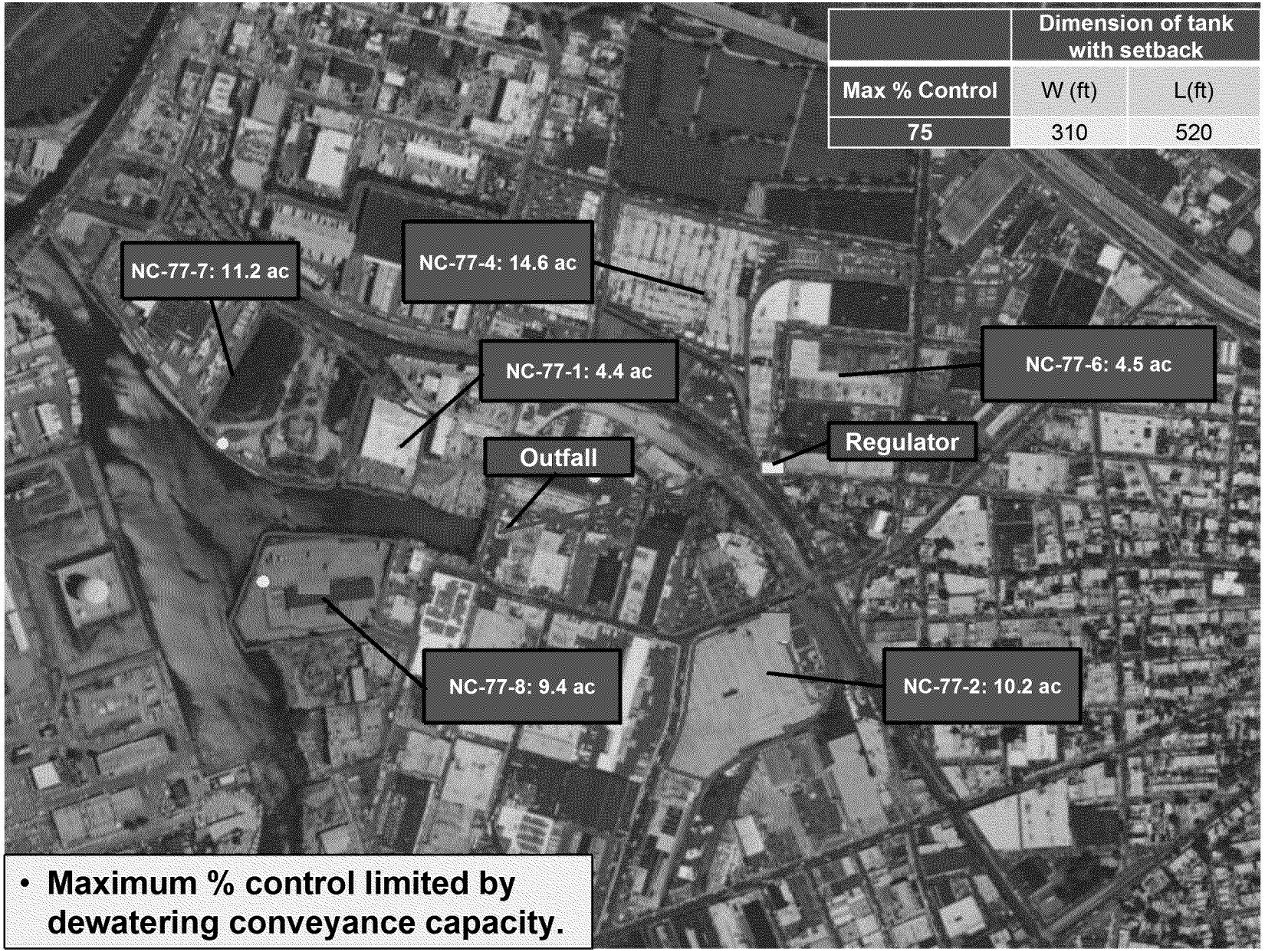
Technology Alternatives for Parcel 77-1

Alternative	Annual Capture Tributary / Basin-Wide (%)	Rec. Season Capture Tributary / Basin-Wide (%)	Volume or Flow	Required Area[1] (ac)	Notes
Vertical Storage Shafts	76% / 20%	77% / 19%	14.4 MG	1.5	Two shafts with 99-ft structural diameter each. Shaft depth of 125 ft. 7MG per shaft based on Dearborn's 7MG VSS.
Storage Tanks	49% / 13%	47% / 12%	6.4 MG	2.3	Tank depth of 30 ft.
Retention Treatment Basin (Recreational Season Operation)	78% / 21%	94% / 23%	113 MGD	2.3	Year-round storage and pump-back.
Screening and Disinfection Basin (Recreational Season Operation)	81% / 21%	100% / 25%	610 MGD	2.3	15-min detention time. Basin depth of 30 ft. Year-round storage and pump-back.
Tunnel	Parcel can be used as a drop shaft/mining shaft site for the tunnel alternative as discussed in later section.				

[1] Required Area includes 50-ft setback.

NC-077 – Potential occupied parcel for CSO Storage

	Dimension of tank with setback	
Max % Control	W (ft)	L(ft)
75	310	520



- **Maximum % control limited by dewatering conveyance capacity.**

NC-077 Outfall – Detailed View

Parcels larger than 0.5 acres within 1/2 mile radius from regulator

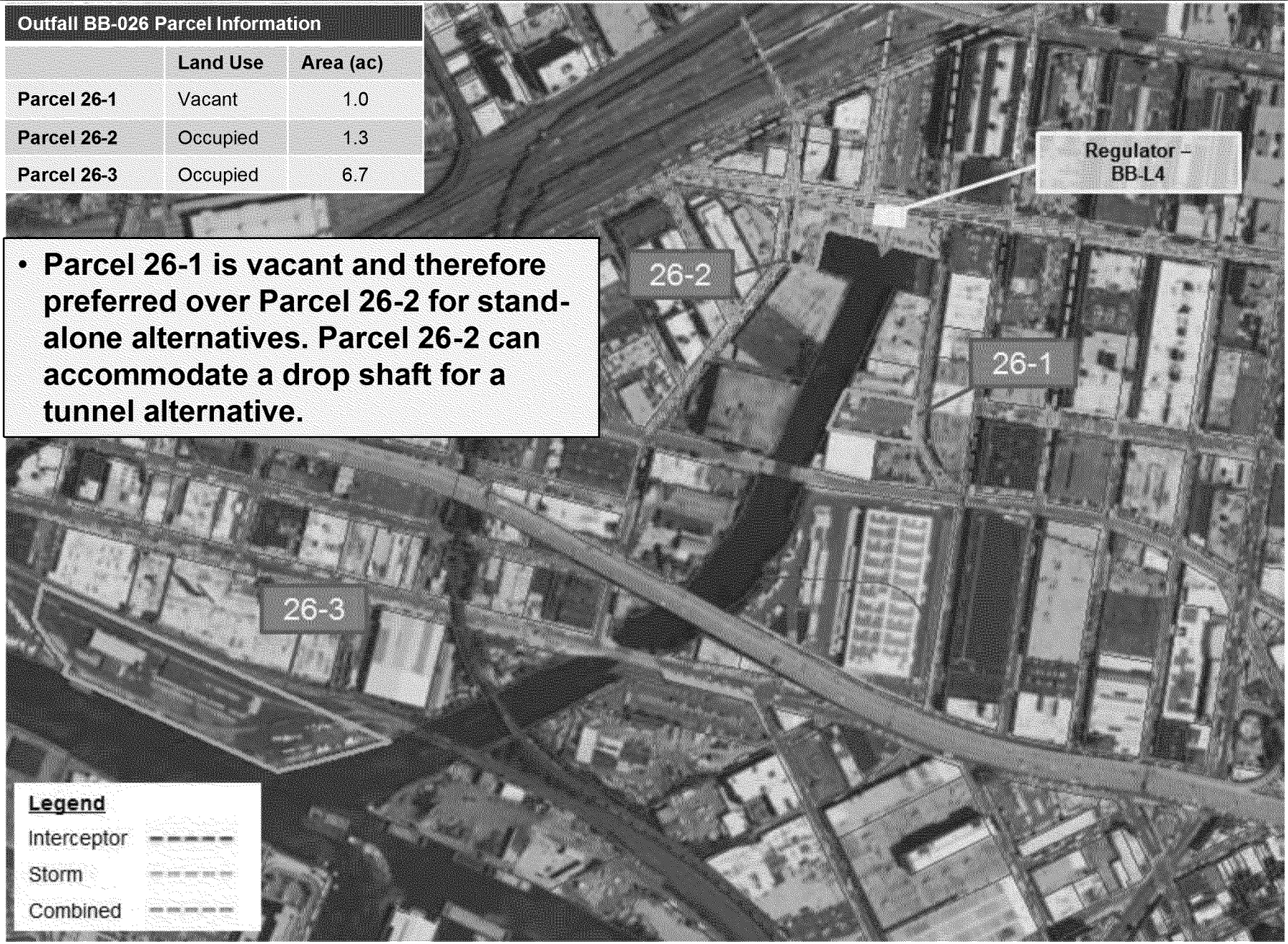
% Annual Control	Storage Tank	
	Required Area[1] (acres)	# of Identified Parcels [2]
25	1.5	55
50	2.4	40
75	3.7	16
100	N/A [3]	

(1) Includes 50 ft. setback.
(2) Cemeteries, schools and rail yards not included.
(3) Limited by dewatering conveyance capacity.

Outfall BB-026: Dutch Kills (Parcel Options)

Outfall BB-026 Parcel Information		
	Land Use	**Area (ac)**
Parcel 26-1	Vacant	1.0
Parcel 26-2	Occupied	1.3
Parcel 26-3	Occupied	6.7

- **Parcel 26-1 is vacant and therefore preferred over Parcel 26-2 for stand-alone alternatives. Parcel 26-2 can accommodate a drop shaft for a tunnel alternative.**



Outfall BB-026: Parcel 26-1 (Land Options)

Assumed 50-ft setback for all alternatives (shown as dashed perimeter).

Technology Alternatives for Parcel 26-1

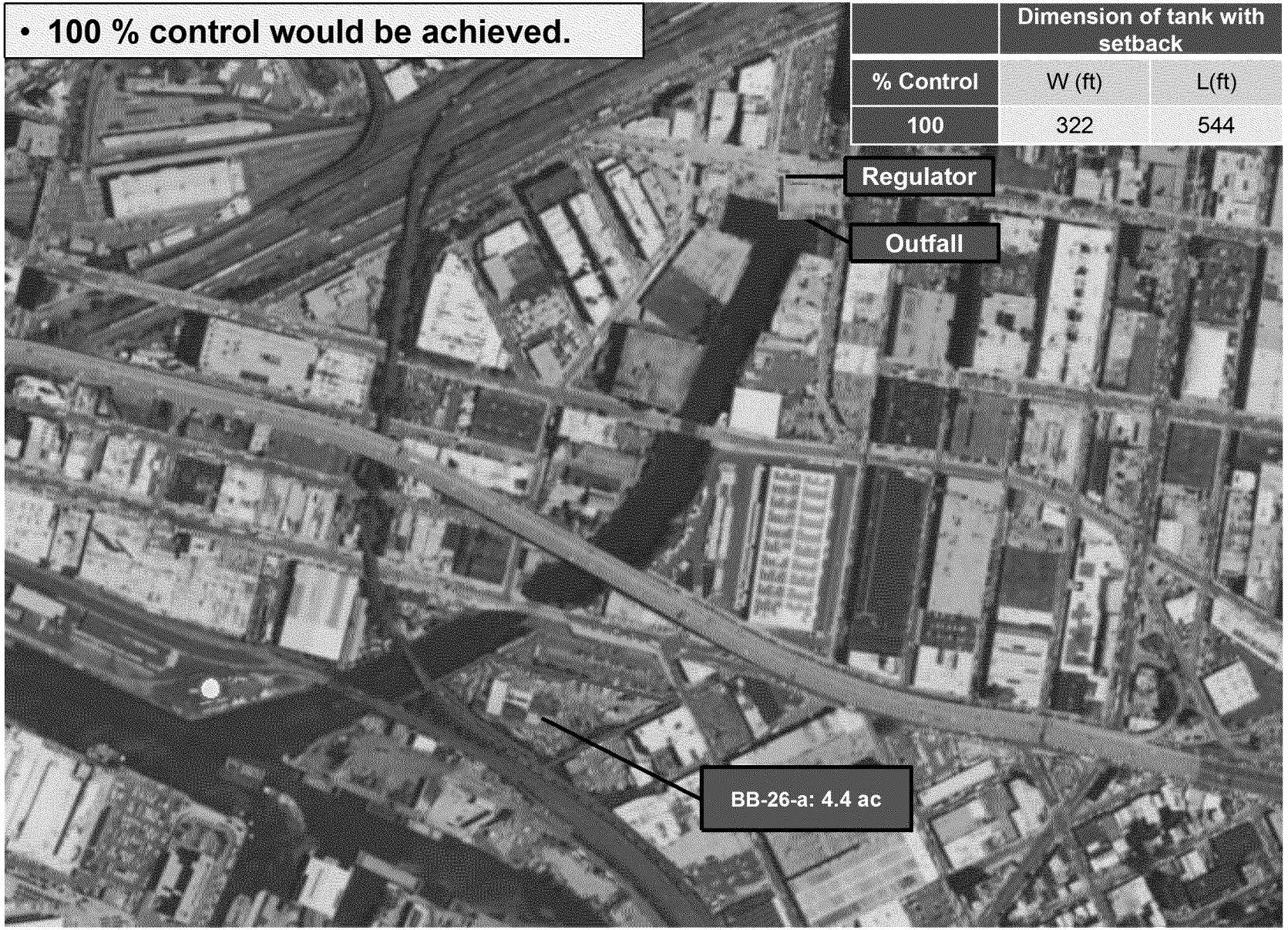
Alternative	Annual Capture Tributary / Basin-Wide (%)	Rec. Season Capture Tributary / Basin-Wide (%)	Required Volume or Flow	Required Area[1] (ac)	Notes
Vertical Storage Shafts	63% / 7%	69% / 7%	5.8 MG	0.9	Two shafts with 63-ft structural diameter each. Shaft depth of 125 ft. 7MG max. per shaft based on Dearborn's 7MG VSS.
Storage Tanks	16% / 2%	15% / 1%	0.8 MG	0.9	Tank depth of 30 ft.
Retention Treatment Basin (Recreational Season Operation)	39% / 4%	57% / 6%	15 MGD	0.9	Year-round storage and pump-back.
Screening and Disinfection Basin (Recreational Season Operation)	62% / 7%	99% / 10%	79 MGD	0.9	15-min detention time. Basin depth of 30 ft. Year-round storage and pump-back.
Tunnel	Parcel can be used as a drop shaft/mining shaft site for the tunnel alternative as discussed in later section.				

[1] 'Required Area' includes 50-ft setback.

BB-026 – Potential occupied parcel for CSO Storage

- 100 % control would be achieved.

	Dimension of tank with setback	
% Control	W (ft)	L(ft)
100	322	544



BB-026 Outfall – Detailed View

Parcels larger than 0.5 acres within 1/2 mile radius from regulator

% Annual Control	Storage Tank	
	Required Area(1) (acres)	# of Identified Parcels(2)
25	1.0	68
50	1.5	35
75	2.3	24
100	4.3	3

(1) Includes 50 ft. setback.
(2) Cemeteries, schools and rail yards not included

In Creek Options - Outfall BB-026

Assumed 25-ft setback for all alternatives

Vertical Storage Shaft (VSS):

- Assumed shaft depth of 125 ft.

Vertical Storage Shaft		
Diameter per Shaft (ft)	Total Volume (MG)	Annual Capture
85	5.3	61%

Storage Tank / RTB:

- Assumed depth of 30 ft.

Storage Tank			
Outside Width (ft)	Outside Length (ft)	Tank Volume (MG)	Annual Capture
85	97	0.3	7%

Retention Treatment Basin			
Outside Width (ft)	Outside Length (ft)	Peak Flow (MGD)	Annual Capture
85	97	6	18%

Under-Creek Box Culvert:

- Assumed 12'x12' pre-cast units

Under-Creek Box Culvert		
Length (ft)	Storage Volume (MG)	Annual Capture (%)
800	0.6	16%

In Creek Options – NC-015, NC-083 and NC-077

Assumed 25-ft setback for all alternatives.

Vertical Storage Shaft (VSS):

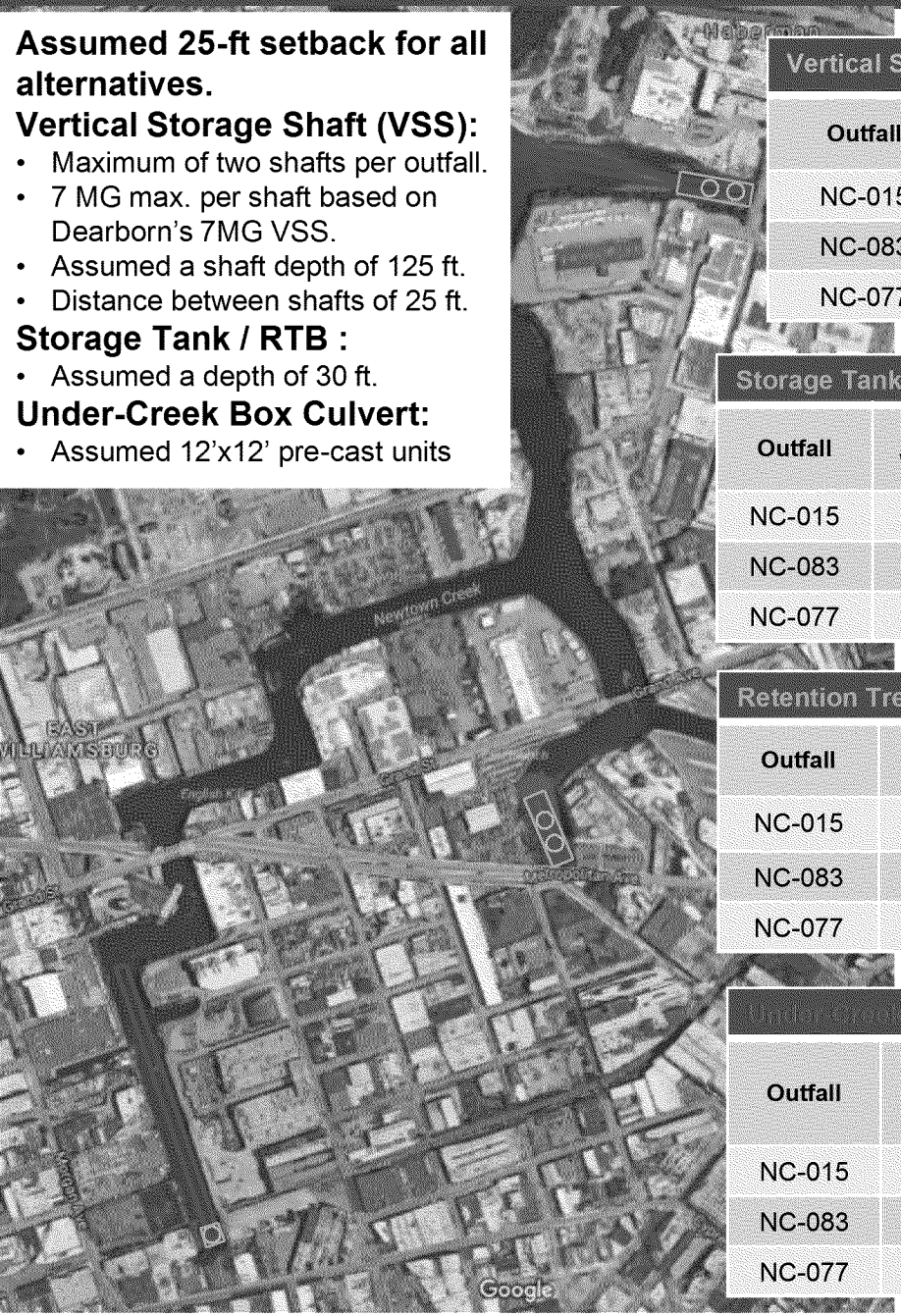
- Maximum of two shafts per outfall.
- 7 MG max. per shaft based on Dearborn's 7MG VSS.
- Assumed a shaft depth of 125 ft.
- Distance between shafts of 25 ft.

Storage Tank / RTB :

- Assumed a depth of 30 ft.

Under-Creek Box Culvert:

- Assumed 12'x12' pre-cast units



Vertical Storage Shafts

Outfall	Diameter per Shaft (ft)	Total Volume (MG)	Annual Capture
NC-015	58	2.5	19%
NC-083	93	12.7	66%
NC-077	87	11.2	68%

Storage Tank

Outfall	Outside Width (ft)	Outside Length (ft)	Tank Volume (MG)	Annual Capture
NC-015	58	65	0.7	<1%
NC-083	93	340	4.8	37%
NC-077	87	232	2.6	27%

Retention Treatment Basin

Outfall	Outside Width (ft)	Outside Length (ft)	Peak Flow (MGD)	Annual Capture
NC-015	58	65	12	1%
NC-083	93	340	85	69%
NC-077	87	232	47	54%

Under-Creek Box Culvert

Outfall	Length (ft)	Storage Volume (MG)	Annual Capture
NC-015	1,500	1.3	7%
NC-083	400	0.3	3%
NC-077	1,100	0.9	9%

Basin Wide Solutions

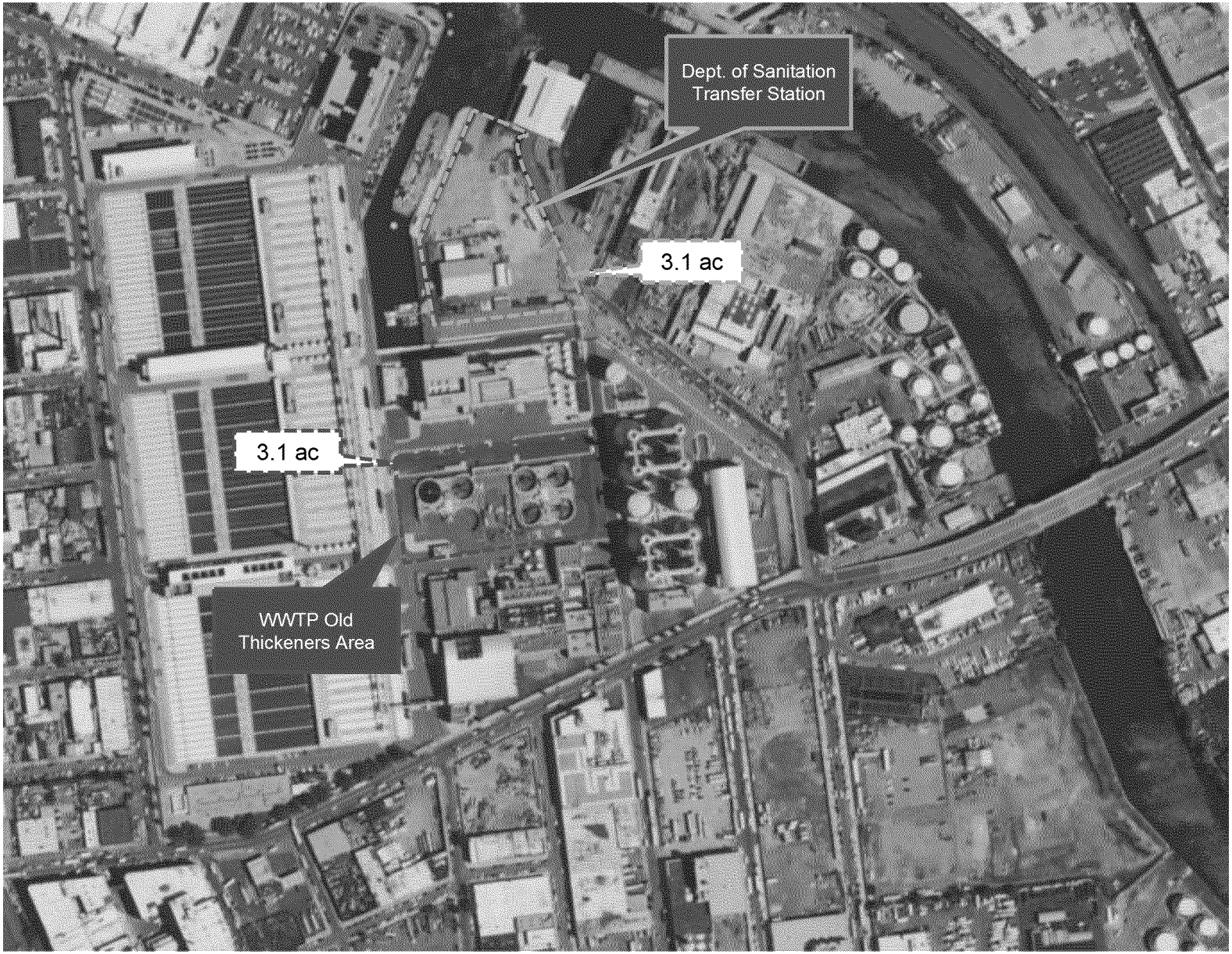
- **Storage**
  - Deep Tunnel
  - Pump-back treated at NC WWTP
- **Conveyance Tunnel and treatment**
  - Retention Treatment Basin or High Rate Clarification
  - Seasonal disinfection.

Required Storage Volume

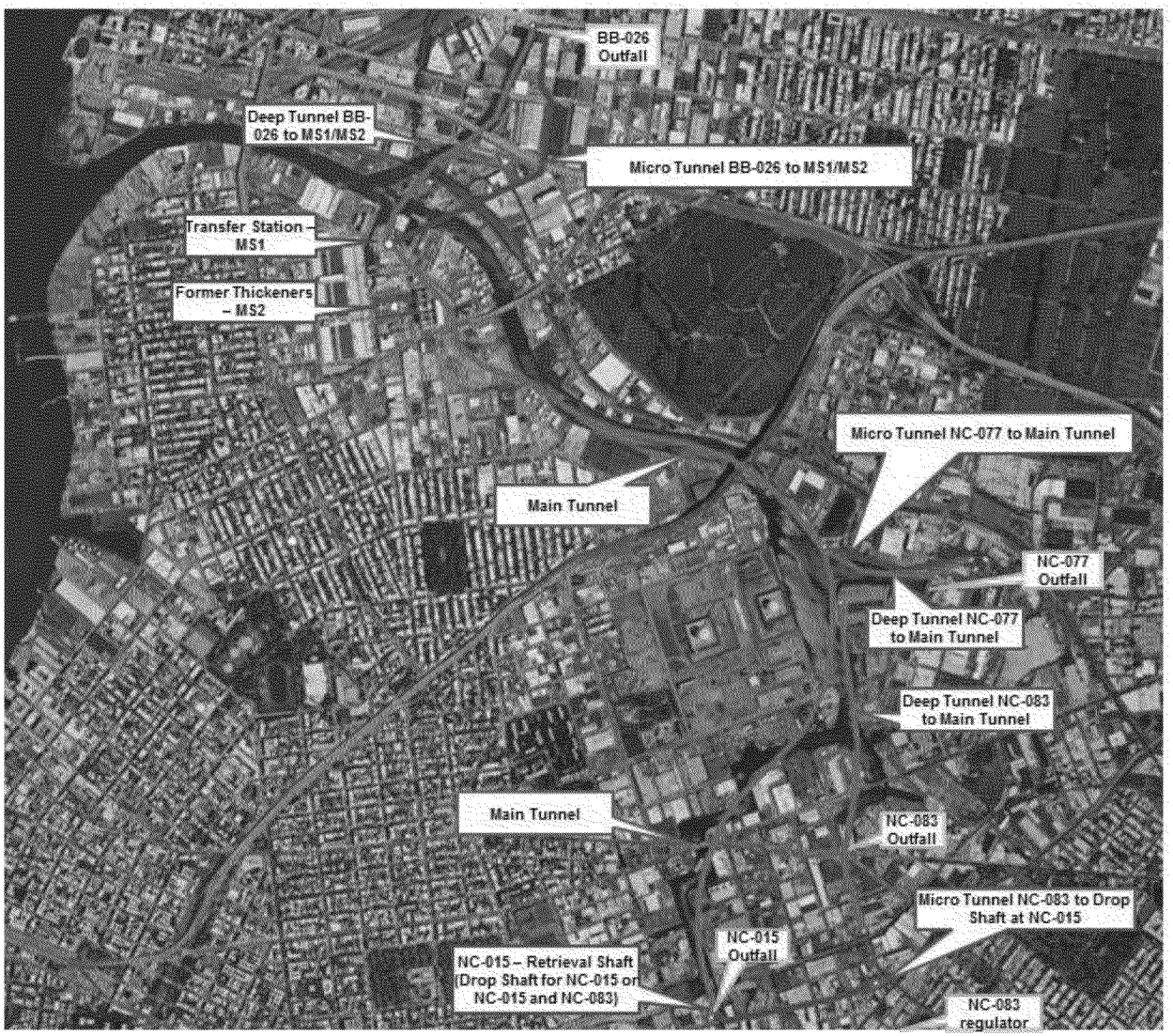
Outfall	25% Outfall Capture	50% Outfall Capture	75% Outfall Capture	100% Outfall Capture
	Storage Volume (MG)	Storage Volume (MG)	Storage Volume (MG)	Storage Volume (MG)
BB-026	1.0	2.7	6.6	17.6
NC-015	4.7	13.1	23.9	51.0
NC-077	2.5	7.1	14.6	38.2
NC-083	2.8	7.9	16.3	38.2
Three Largest Outfalls	**10**	**28**	**55**	**127**
Four Largest Outfalls	**11**	**31**	**61**	**145**
Three largest basin-wide capture	20%	39%	59%	79%
Four Largest basin-wide capture	22%	46%	68%	92%

[1] 'All Other NC Outfalls' includes 11 outfalls from Bowery Bay and 4 outfalls from Newtown Creek.

Mining Shaft Siting Options



Basin Wide Storage: Deep Tunnels – In Creek



Capture four largest outfalls – No micro-tunnels			
CSO capture	Diam. (ft)	Length (lf)	Volume (MG)
100%	33	23,500	150
75%	22	23,500	64
50%	15	23,500	31
25%	9	23,500	11

Capture four largest outfalls – All branches micro-tunneled			
CSO capture	Diam. (ft)	Length (lf)	Volume (MG)
100%	43	13,700	148
75%	28	13,700	63
50%	20	13,700	32
25%	12	13,700	12

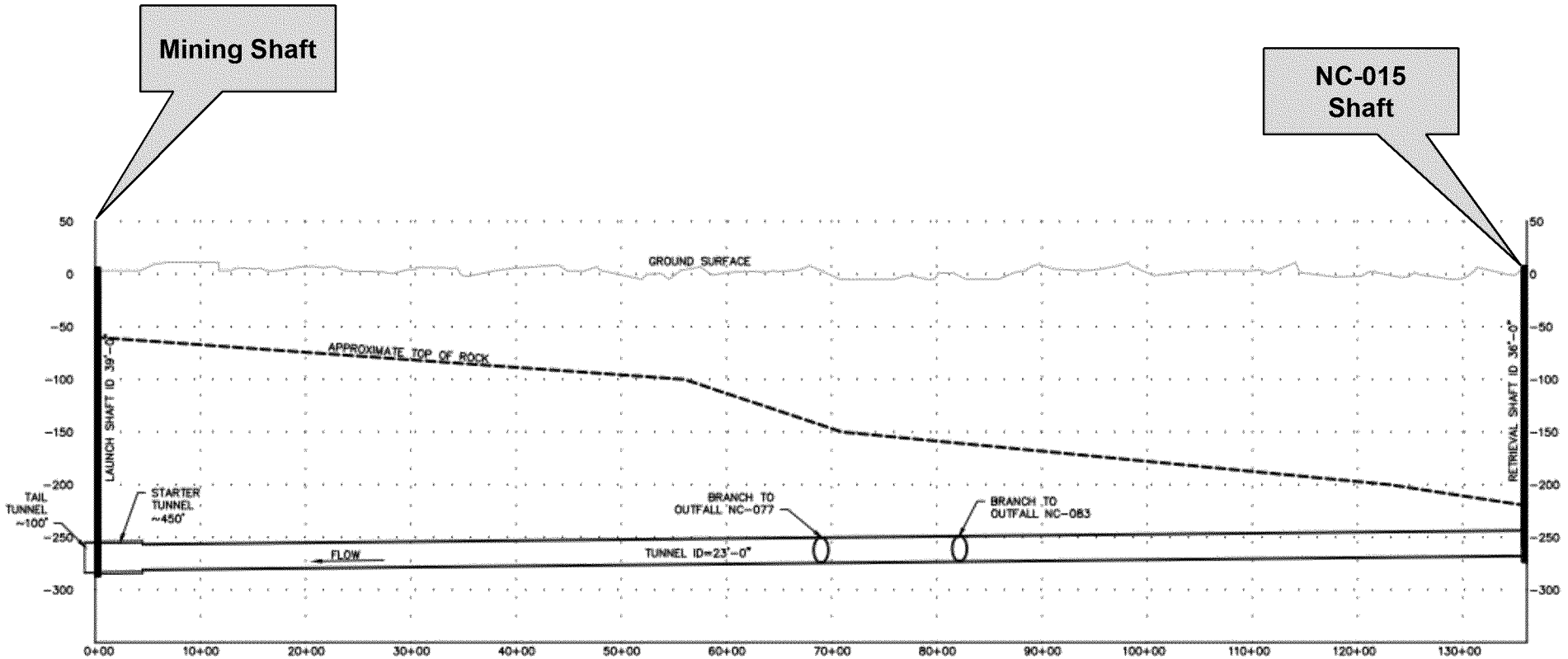
Capture three largest outfalls – Deep tunnel branches for NC-083 and NC-077			
CSO capture	Diam. (ft)	Length (lf)	Volume (MG)
100%	34	19,900	131
75%	22	19,900	57
50%	16	19,900	28
25%	10	19,900	10

Capture three largest outfalls – Micro-tunnels for NC-083 and NC-077			
CSO capture	Diam. (ft)	Length (lf)	Volume (MG)
100%	40	13,700	130
75%	26	13,700	55
50%	19	13,700	28
25%	11	13,700	10

Capture 4 largest outfalls		
CSO capture	Main tunnel diam. range (ft)	Preliminary PBC range ($M)
100%	33-43	395 to 1,690
75%	22-28	
50%	15-20	
25%	9-12	

Capture 3 largest outfalls		
CSO capture	Main tunnel diam. range (ft)	Preliminary PBC range ($M)
100%	34-40	405 to 1,640
75%	22-26	
50%	16-19	
25%	10-11	

Deep Tunnels –Typical longitudinal profile – hard rock



Deep Tunnels – Mining shaft typical layout – Transfer Station

PLAN VIEW LAUNCH SHAFT LAYOUT

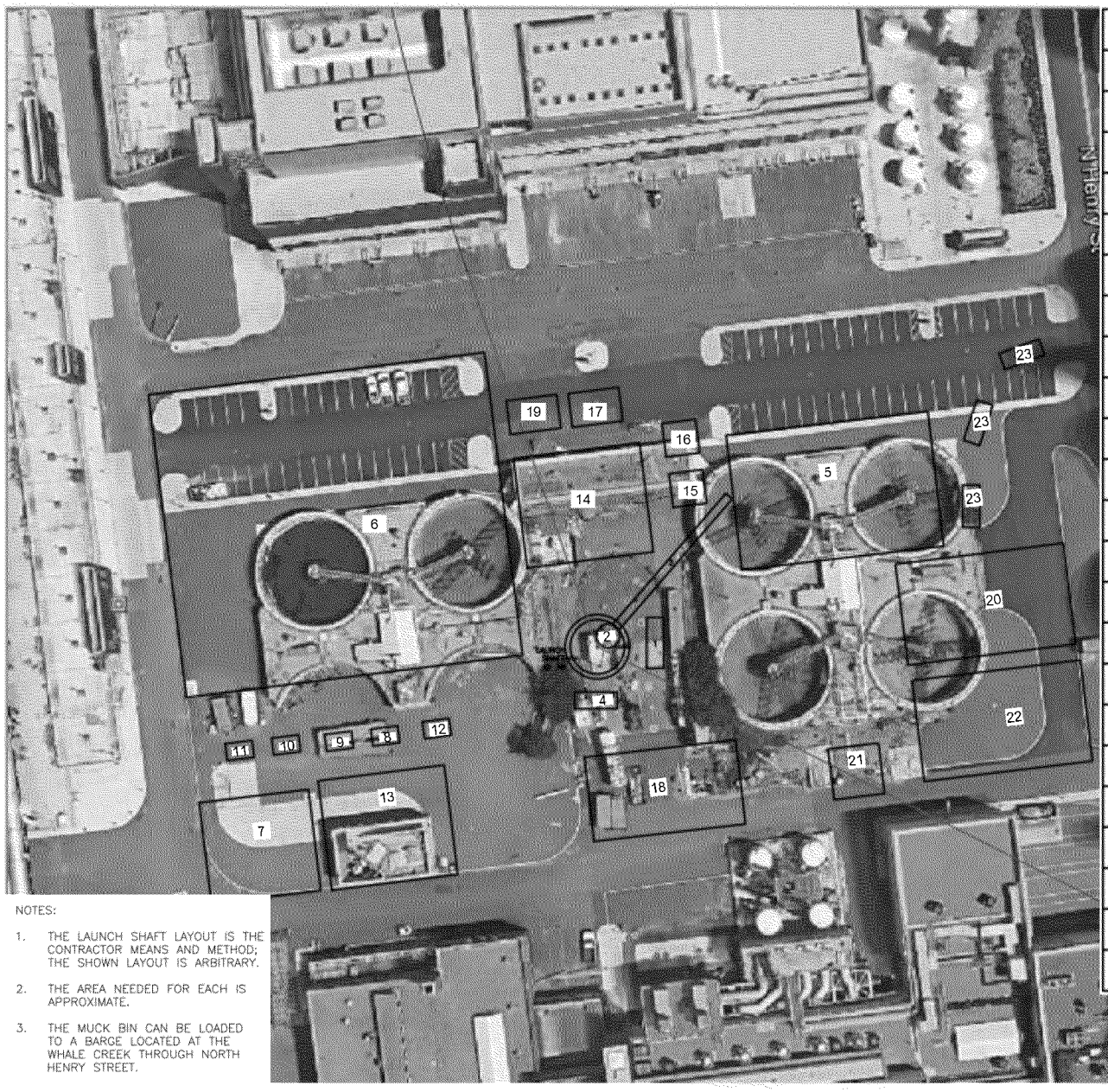
NOTES:

1. THE LAUNCH SHAFT LAYOUT IS THE CONTRACTOR MEANS AND METHOD; THE SHOWN LAYOUT IS ARBITRARY.
2. THE AREA NEEDED FOR EACH IS APPROXIMATE.
3. THE MUCK BIN CAN BE LOADED DIRECTLY TO A BARGE LOCATED AT THE WHALE CREEK.

AREA #	ITEM	AREA (ft^2)
1	GANTRY CRANE	30'X10'
2	VERTICAL SPOIL CONVEYOR	RADIUS 7'
3	HORIZONTAL SPOIL CONVEYOR	–
4	AIR VENTILATOR (FANS)	25'X10'
5	MAIN SPOIL BIN	120'X80'
6	SEGMENT/TBM YARD	200'X180'
7	WORKSHOP/TOILETS/ CRIBROOM/SITE OFFICE	65'X60'
8	COMPRESSION CHAMBER	16'X10'
9	EQUIPMENT STORE	16'X10'
10	MECHANICAL STORE	16'X10'
11	ELECTRICAL STORE	16'X10'
12	OXY STORAGE	16'X10'
13	PIPE & BRACKET STORAGE	65'X75'
14	TBM RAIL ASSEMBLY YARD	65'X75'
15	WATER COOLING PLANT	20'X20'
16	AIR COMPRESSOR	20'X20'
17	GROUT PLANT	30'X20'
18	STORAGE LAYDOWN AREA	90'X50'
19	BUNDED CHEMICAL	20'X30'
20	WATER TREATMENT PLANT	65'X100'
21	HIGH VOLTAGE SWITCH YARD	30'X30'
22	MAIN SITE (PROJECT) OFFICES	60'X100'

Deep Tunnels – Mining shaft typical layout – Former Thickeners @ WWTP

NYC Environmental Protection



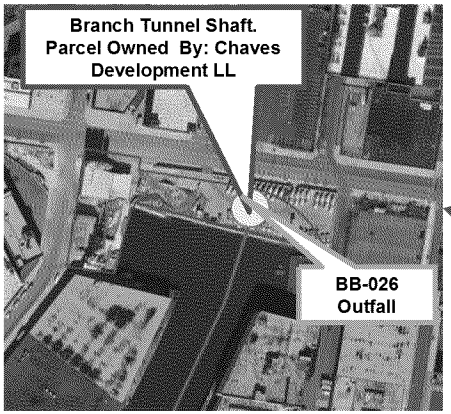
AREA #	ITEM	AREA (ft^2)
1	GANTRY CRANE	30'X10'
2	VERTICAL SPOIL CONVEYOR	RADIUS 7'
3	HORIZONTAL SPOIL CONVEYOR	–
4	AIR VENTILATOR (FANS)	25'X10'
5	MAIN SPOIL BIN	120'X80'
6	SEGMENT/TBM YARD	200'X180'
7	WORKSHOP/TOILETS/ CRIBROOM/SITE OFFICE	65'X60'
8	COMPRESSION CHAMBER	16'X10'
9	EQUIPMENT STORE	16'X10'
10	MECHANICAL STORE	16'X10'
11	ELECTRICAL STORE	16'X10'
12	OXY STORAGE	16'X10'
13	PIPE & BRACKET STORAGE	65'X75'
14	TBM RAIL ASSEMBLY YARD	65'X75'
15	WATER COOLING PLANT	20'X20'
16	AIR COMPRESSOR	20'X20'
17	GROUT PLANT	30'X20'
18	STORAGE LAYDOWN AREA	90'X50'
19	BUNDED CHEMICAL	20'X30'
20	WATER TREATMENT PLANT	65'X100'
21	HIGH VOLTAGE SWITCH YARD	30'X30'
22	MAIN SITE (PROJECT) OFFICES	60'X100'
23	MUCK TRUCKS TO WHALE CREEK	–

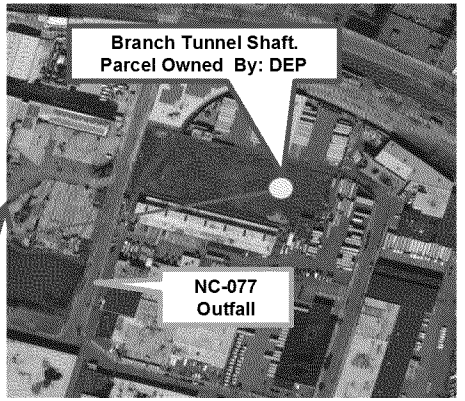
NOTES:

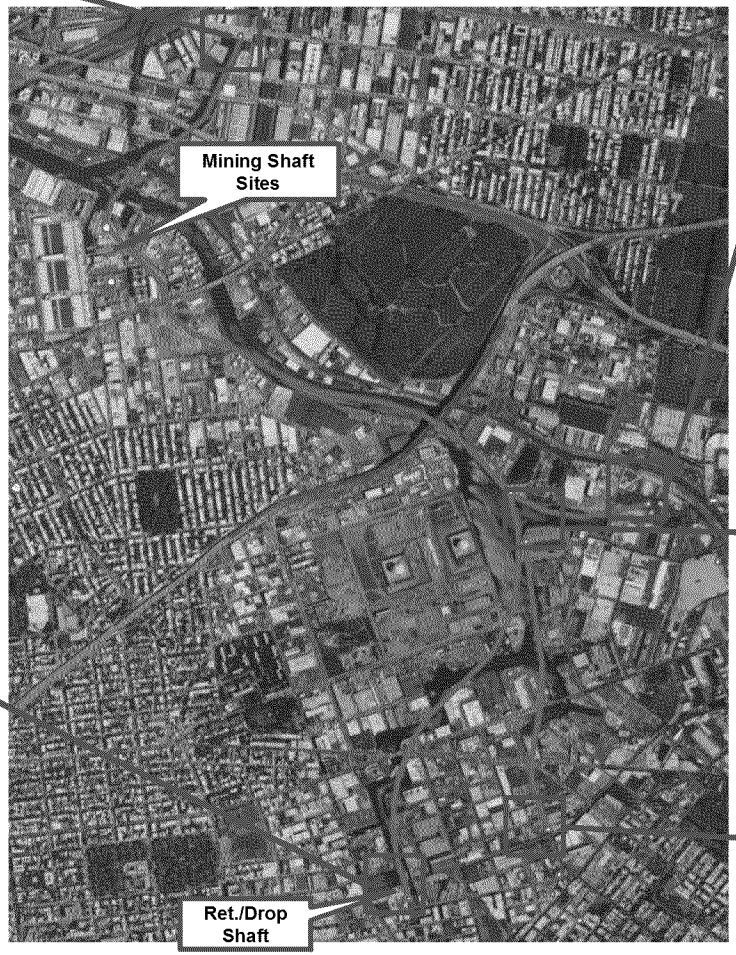
1. THE LAUNCH SHAFT LAYOUT IS THE CONTRACTOR MEANS AND METHOD; THE SHOWN LAYOUT IS ARBITRARY.
2. THE AREA NEEDED FOR EACH IS APPROXIMATE.
3. THE MUCK BIN CAN BE LOADED TO A BARGE LOCATED AT THE WHALE CREEK THROUGH NORTH HENRY STREET.

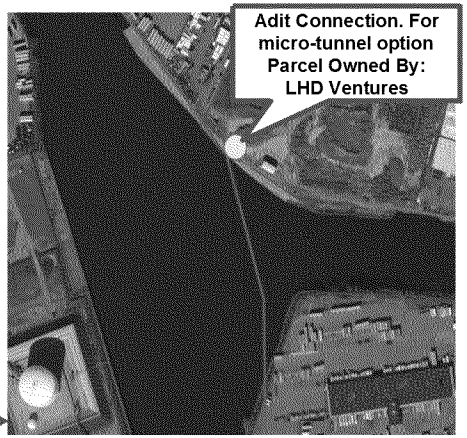
PLAN VIEW LAUNCH SHAAFT LAYOUT

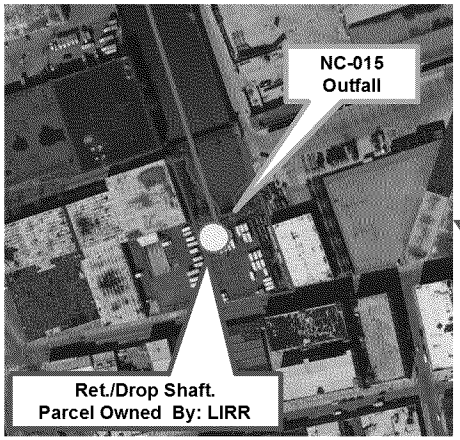
Alt. 1: Four Outfall Tunnel In-Creek: Details

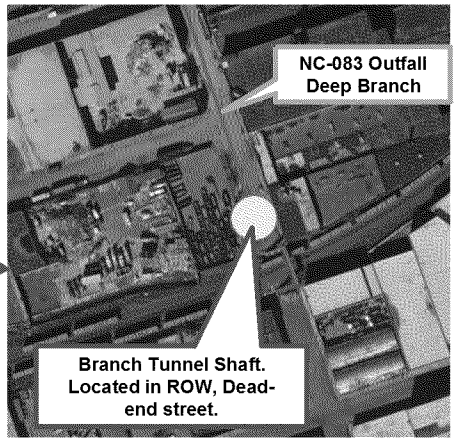












Basin Wide Storage: Deep Tunnels – ROW

Capture four largest outfalls – Deep Tunnel Branch for BB-026			
CSO capture	Diam. (ft)	Length (lf)	Volume (MG)
100%	34	22,350	152
75%	22	22,350	64
50%	15	22,350	31
25%	10	22,350	12

Capture four largest outfalls – Micro-tunnel for BB-026			
CSO capture	Diam. (ft)	Length (lf)	Volume (MG)
100%	37	18,800	151
75%	24	18,800	64
50%	17	18,800	32
25%	10	18,800	11

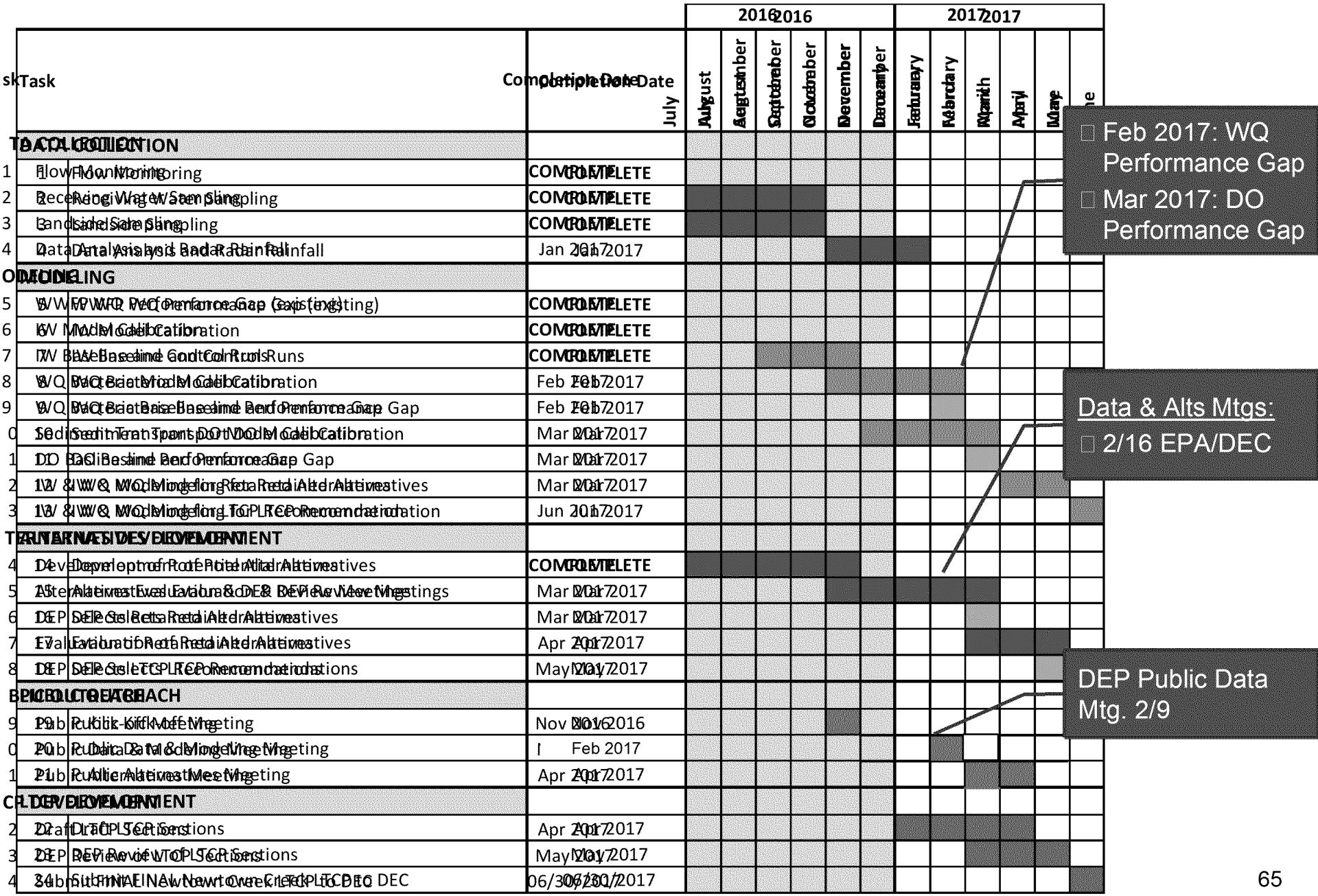
Capture 4 largest outfalls		
CSO capture	Main tunnel diam. range (ft)	Preliminary PBC range ($M)
100%	34-37	470 to 1,420
75%	22-24	
50%	15-17	
25%	10	

Capture three largest outfalls				
CSO capture	Diam. (ft)	Length (lf)	Volume (MG)	Preliminary PBC range ($M)
100%	35	18,800	135	470 to 1,320
75%	23	18,800	58	
50%	16	18,800	28	
25%	10	18,800	11	

LTCP Schedule

Newtown Creek LTCP Development Schedule

Task		Completion Date
DATA COLLECTION		
1	Flow Monitoring	COMPLETE
2	Receiving Water Sampling	COMPLETE
3	Landside Sampling	COMPLETE
4	Data Analysis and Rainfall	Jan 2017
MODELING		
5	WW WQ Performance Gap (existing)	COMPLETE
6	WW Model Calibration	COMPLETE
7	WW Baseline and Control Runs	COMPLETE
8	WQ Water Model Calibration	Feb 2017
9	WQ Baseline Performance Gap	Feb 2017
10	Sediment Transport Model Calibration	Mar 2017
11	DO Baseline Performance Gap	Mar 2017
12	WW & WQ Modeling for Retained Alternatives	Mar 2017
13	WW & WQ Modeling for LTCP Recommendation	Jun 2017
ALTERNATIVES DEVELOPMENT		
14	Development of Potential Alternatives	COMPLETE
15	Alternatives Evaluation & DEP Review Meetings	Mar 2017
16	DEP Selects Retained Alternatives	Mar 2017
17	Evaluation of Retained Alternatives	Apr 2017
18	DEP Selects LTCP Recommendations	May 2017
PUBLIC OUTREACH		
19	Public Kick-off Meeting	Nov 2016
20	Public Data & Modeling Meeting	Feb 2017
21	Public Alternatives Meeting	Apr 2017
LTCP DEVELOPMENT		
22	Draft LTCP Sections	Apr 2017
23	DEP Review of LTCP Sections	May 2017
24	Submit FINAL Newtown Creek LTCP to DEC	06/30/2017



- Feb 2017: WQ Performance Gap
- Mar 2017: DO Performance Gap

Data & Alts Mtgs:
- 2/16 EPA/DEC

DEP Public Data Mtg. 2/9

Next Steps